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PHILOSOPHY.

THE SYNTHETIC PHILOSOPHY AN ORGANON OF THE SCIENCES.

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Philosophy, from whatever point of view it may begin its investigations, attempts the solution of the most difficult problem which can possibly engage the thought of the human mind. It attempts to construct a rational theory of the universe by the formulation of some all-embracing truth or principle which shall serve as the ground and explanation of all things as these appear in the bounds of space and in the evolutions of time. Of the deep interest which man must ever feel in the question of his relation to the universe, Schelling has truly said, "Would man strive to fathom this relation? I answer, if he would not, still he must. He always has striven after it; and, in the future, he always will strive after it."

The problem which philosophy attempts to solve is altogether of a different order from those which science deals. Science is satisfied when it can discover the nature of the phenomena belonging to a special province of nature, and can formulate the laws regulating their co-existences and sequences. Science analizes nature into parts, in order that man may attain a point of attack by which to gain control over her laws and forces. On the other hand, philosophy aims to reduce the thought-world to unity, which has been destroyed by the analytic processes of science. As the mind, in order to the harmony and completeness of thought, demands both analysis and synthesis, so we must have both science and philosophy. Philosophy justifies itself to science by showing that the methods and fundamental ideas of the latter are inadequate to their own explanation.

Hence, philosophy is defined by Hamilton as *the science of first principles*, and by Spencer as *completely unified knowledge*.

Having briefly stated the aim and scope of philosophy in general, we will be the better enabled to understand the special aims and scope of the Synthetic Philosophy as set forth by Herbert Spencer. In this system of philosophy we find exemplified the strongest intellectual tendencies of the age. If we would know what class of questions is stirring most deeply the minds of thoughtful persons; if we would know in what direction the thought of many of the leading minds of the age is traveling, then we must study the Synthetic Philosophy. It is not too much to say that the man who has not done this cannot properly estimate the intellectual characteristics and tendencies of the age. Philosophy, as we have seen, aims to reduce all causes to one cause, all laws to one law, and all phenomena to one primordial source of being, that man may see the many in the one, and the one in the many. The Synthetic Philosophy claims to have done this by establishing the universal law of Evolution. For this reason Mr. Spencer has termed his system the Synthetic Philosophy, because it aims to construct by means of the law of Evolution a harmonious and consistent *organon* out of all the departments of knowledge.

To one not correctly informed, the word Evolution is full of materialistic and atheistic associations, as though it were a denial of the spirituality of man and the existence of God. Nothing can be farther from the truth than such an idea. Evolution, so far from aiming to set aside the idea of a first Creative Cause, claims to be the manifestation of a Power which no human thought can fully comprehend. It teaches that the postulate of Absolute Being is alike essential to both science and religion. "Both religion and science," says Mr. Spencer, "are obliged to assert the existence of an Ultimate Reality. Without this religion has no subject matter; and without this science, subjective and objective, lacks its indispensable datum." Persons having only a partial knowledge of the Synthetic Philosophy have made the mistake of supposing that it makes *force* its ultimate postulate, and that hence the idea of Absolute Being or God is rejected. This mistake is less excusable from the fact that Mr. Spencer has used great clearness and fullness of statement to prevent his readers from falling into this very error. He says, "Over and over again, it has been shown in various ways that the deepest truths we can reach, are simply statements of the widest uniformities in our experience of the relations of matter, motion and force; and that matter, motion and force are but symbols of the Unknown Reality." We thus see that *force* is not the Ultimate Reality, but the symbol of the Ultimate Power which ever works throughout all nature, and "in which we live and move and have our being." No philosopher goes beyond Mr. Spencer in emphasizing Absolute Being as the ultimate datum of all science, philosophy and religion. He says: "By the very conditions of thought we are prevented from knowing anything but relative being; yet by these very conditions of thought, an indefinite consciousness of Absolute Being is necessitated." He, in common with all other philosophers,

makes Absolute Being the ultimate principle of philosophy; the only difference being that while they ascribe to this Ultimate Power personal attributes, he regards this as unknowable, and hence as not admitting of the predication of such attributes. He says: "All philosophers avowedly or tacitly recognize this same ultimate truth:—that while the Relativist rightly repudiates these definite assertions which the Absolute makes respecting existence transcending perception, he is yet at least compelled to unite with him in predicating existence transcending perception." While regarding Absolute Being as only indefinitely apprehended by consciousness, its existence is with him none the less certain. He says: "The existence of this inscrutable Power is the most certain of all truths."

In developing his comprehensive system of phllosophy, it devolved upon Mr. Spencer, at the outset, to define what he regards as the true scope of philosophy. Regarding philosophy as a synthesis of the most general truths of science, while science itself deals solely with proximate, not ultimate causes, it follows that the findings of philosophy from his stand-point are confined to the sphere of such causes as are manifested in the uniformities of cosmical phenomena. Hence, the Synthetic Philosophy does not, like the German Philosophy, enter the sphere of Ontology, and attempt to explain the mysteries of Absolute Being. Regarding such a task as beyond the powers of the human mind, it confines itself to the sphere of the finite and relative. It attempts through the law of Evolution to unify the various orders of cosmic phenomena—to show how the different sciences, such as astronomy, geology, biology, psychology and sociology, can be logically articulated into a single harmonious and consistent body of established truth through one fundamental and all-pervading law or principle. Hence, the merits of this philosophy must be judged solely by its success in bringing within this comprehensive synthesis all the various ranks and orders of cosmic phenomena. Mr. Spencer terms his system the Synthetic Philosophy for the reason that its great organizing law is Evolution, within the comprehensive synthesis of which all cosmic phenomena find their unity and explanation. Prof. Fiske, the able expounder of this system, prefers the term *Cosmic*, for the reason that it distinguishes this system from those ontological forms of philosophy which treat of Absolute Being. Any one is at liberty to raise with Mr. Spencer an issue regarding the possibility of constructing an Ontology; but this would be a psychological question concerning the powers of the human mind. Such a question would no more involve either the truth or the untruth of the evolution philosophy than the old question concerning the nature of gravitation—whether it is due to action at a distance or to ethereal pressure, involves the truth of the Newtonian system of astronomy. Modern astronomy rests on the *truth* of gravitation as the great law of space, and not on any theory concerning its ultimate nature. In like manner, Evolution as the great law of time, rests on the persistence or indestructibility of force, regardless of any theory we may hold concerning the nature of Absolute Being, of which force and motion are to us but the sensible symbols. We may agree with Mr. Spencer in denying that personal attributes can be predicated of

this Power, or we may, in common with many evolutionists, predicate of this Power such attributes, and still hold to the theory of Evolution. This theory concerning the relativity of knowledge was borrowed by Spencer from Hamilton, and hence does not enter as a logical element into the formula of Evolution.

These are distinctions which need to be made if we would form a just estimate of the merits of the Synthetic Philosophy. Evolution claims to be an explanation of proximate causes, laws and origins, not of ultimate ones. The opponents of evolution seem utterly unable or unwilling to understand this distinction. Even Agassiz, who ought to have understood this, failed to do so in his latest utterances. He says: "How the world originated is the great question, and Darwin's theory, like all other attempts to explain the origin of life, is thus far merely conjectural." Darwin's theory, which is a special phase of evolution, does not attempt to explain the origin of life, but the *origin of species*. Again, it is manifestly unfair to criticise adversely the Synthetic Philosophy for its failure to construct an ontology which shall explain ultimate causes and origins. The merits of a science or philosophy should be judged solely by its success in dealing with those questions which belong to its own self-chosen sphere of thought. Such a confusing of the question is to be regretted, both for the sake of science and theology. It brings issues into scientific discussion which have no business there, by confounding proximate and ultimate causes. It does harm to theology by exciting in the minds of religious people needless fears, causing them to regard science, and especially evolution, as hostile to their religion.

Now, to properly understand Evolution, we must view it as the law which formulates *successions* in time. Whether it is the savage or the philosopher who looks out upon the face of nature, the most imposing and impressive feature is *motion*, or ceaseless activity. All Nature is one vast rhythm of action and reaction, endless processions and recessions. Amid this perpetual conflict of forces, this continual becoming and ceasing to be, land and sea are ever striving for the mastery. The sea is ever being carried away in the form of vapor to the tops of the hills and the mountains, while the hills and the mountains, the symbols of durability, are slowly but surely traveling to the sea. Nature, "red of tooth and claw," has ever been hunting down without pity or remorse the living forms which make up the long procession of life. Man and his works, like all below him, are ever whirled onward in this mighty torrent of change which allows nothing to endure in fixed and stable form. We mark the ages of history by the different types of men and civilizations which have risen and flourished during their brief day, and then disappeared to be succeeded by new phases in the movement of Humanity. We thus see event following event, the cause ever passing into the effect, and the antecedent becoming incorporated into the consequent amid the ceaseless successions of time.

But the savage and the philosopher assume toward these ceaseless changes of nature very unlike mental attitudes. In the mind of the one those varied phases of nature form an undiscriminated congeries of impressions, with no fixed

law or order; in the mind of the other there is an abiding conviction that amid all the manifold changes which make up the world of phenomena, there is in the innermost determination of things a unity of plan ever working toward the realization of definite ends. To the savage, nature is a Sibyl whose scattered leaves have no meaning; to the philosopher who carefully collects her leaves and places them in their true connection, she reveals the mysteries of ancient time. To trace out the genetic successions and correlations in cosmic phenomena, to show how one stage or epoch has unfolded out of its antecedent, and how this, in turn, will unfold into its consequent—in a word, to formulate the universal law of *sequence* which holds in all orders of phenomena, is the object of the law of Evolution. We agree with Prof. Le Conte in regarding Evolution as the grandest idea of modern science, embracing, as it does, at least one-half of all science, and this by far the most interesting and important half. "A most valuable habit," says Mr. J. J. Murphy, "has become general among men of mental cultivation, of regarding every object, not as if it were alone and isolated, but in its connection with other objects." Man as a being "looking before and after," in order to satisfy the demands of his mental nature, earnestly desires to know the causes which have operated to produce the present order and relation of things. The mind accepts as a satisfactory explanation of any class of phenomena when it knows the dynamic laws, by the operation of which cognizable objects acquire and lose the sensible forms under which they assert themselves to consciousness. This manner of investigation, made familiar by Evolution, is termed the *genetic* method, because it investigates phenomena in their historic successions as manifested in the relations of each phase of a subject to preceding and succeeding phases. The phenomenon which at a particular period of time manifests itself to us does not reveal the totality of its nature, properties and relations. The genetic method, going back by *analysis*, tends to reduce diversities to a primitive identity, and advancing forward by *synthesis* finds the primitive identity disappearing in diversity. By the former process science reconstructs the past; by the latter it constructs the future. By this method we interpret the present by the past, the complex by the simple, and the fully developed product by the rudimentary form.

This desire of man to know the past and to connect it organically with the present accounts for the fact that Evolution has been so generally received by the thinking class of persons. This law offers the only rational solution which our faculties permit us to perceive as to the mode of origin of the present cosmical order from primitive, antecedent conditions. From the time that Newton taught mankind to modify their idea of cause into the conception of *mechanical force*, and thence to look at nature from a dynamic point of view, the scientific mind has been advancing with sure step to Evolution as the final, logical outcome. To understand Evolution, we must study its fundamental characteristics. But it is from biology, the fundamental category of which is *organism*, that we get our clearest conception of those essential characteristics which constitute evolution,

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or development. The growth of a plant or an animal from the simple germ "is the typical specimen of a phenomenon which rules through the whole course of the history of man and society—increase of function through expansion and differentiation of structure by internal forces." It will then be best to define and illustrate the fundamental characteristics of Evolution from the standpoint of organic phenomena.

1. *The homogeneous:*—Embryology has revealed the fact that the complex animal organism is developed from a simple germ which, because of a sameness of structure, is characterized by the term *homogeneous*. "However much," says Beale, "organs and their tissues in the fully formed state may vary as regards the character, properties and compositions of the formed material, all were first in the condition of clear, transparent, structureless living matter." But this homogeneous, structureless protoplasm is unstable, and must therefore differentiate itself, or develop into an unlikeness of parts, because of the vast amount of locked up energy which it contains. Hence, it assumes a dynamic relation to itself, in order that it may unfold into its higher self, and realize the ideal of growth and development stamped upon its inmost constitution, and which is but the full unfolding of the promise and potency enfolded in the original germ.

2. *The heterogeneous:*—The final state into which the homogeneous and structureless matter of life unfolds is characterized as *heterogeneous*. This final state, in contrast to the primitive simplicity out of which evolution arises, is characterized by a structural difference among the coëxistent parts which become endowed with diverse functions. In the primitive homogeneous state there is no definite and coherent relation among the parts. In the final heterogeneous state, sameness has developed into diversity, simplicity into complexity, in which there is a definite and coherent relation among the parts.

The vital movement by which life passes from this primitive simplicity to its final complexity is a double movement, and is expressed by the terms *integration* and *differentiation*.

3. *Integration:*—By integration is meant in Evolution the process by which the different parts of a structure or organsm are knit together into organic unity through their mutual dependence and coöperation. The degree of coherency and dependence among the different parts of an evolved structure is determined by the degree of complexity and specialization of functions. An increasing specialization among the functions brings with it an increasing efficiency, and, at the same time, an increasing dependency and coherency, for the reason that as each organ becomes more specialized, it is less able to perform any other than its own allotted function. Some living beings, as the *amœba*, are so low down in the scale of life that they have no specialization of parts. Foot, head and stomach are extemporized for the occasion. Integration is consequent upon a loss of motion, so that the different parts are allowed to come into combining and coöperative relations.

4. *Differentiation:*—By differentiation is meant in Evolution the process by

which an unfolding structure becomes endowed with diverse functions. By virtue of the marvelous changes due to differentiation, two vital germs, apparently similar in nature, develop into two living beings widely dissimilar in form and nature; one may develop into the serpent which crawls in the dust, the other into the bird of-paradise which makes the forest glorious with its beauty. Integration and differentiation in organic evolution supplement each other. Without the former there would be no organic unity, but a mere assemblage of parts, each existing and acting for itself. Without the latter there would be no specialization of structures and functions, but a mere aggregation of parts.

These principles, as worked out by Mr. Spencer, constitute the essential characteristics of evolution, which, as he has shown, applies to all orders of phenomena, whether organic or inorganic, as the universal law of the redistribution of matter, force and motion. We may define thus: *Evolution is an orderly and successive series of changes from a simple and homogeneous state to one that is complex and heterogeneous, through the twofold process of integration and differentiation consequent upon a loss of motion.*

It has been said by its opponents that Evolution is only a hypothesis. This we admit; but no one acquainted with the logic of science would argue from this that it should be regarded as false. If sustained by facts, if it explains what would otherwise remain unexplained, while, at the same time, it is not contradicted by any known principle of nature, then a scientific hypothesis is to be regarded as true. Science is largely built upon hypotheses of this character, such as the undulatory theory of light, and the molecular and atomic theories of matter. As to absolute certainty, this is beyond the powers of inductive investigation, as we are taught by the ablest writers on the logic of science. "The theory of Spencer, says Prof. Jevons in his work on *The Principles of Science*, "is to some extent hypothetical, just as all the theories of physical science are to some extent hypothetical, and open to doubt. Judging from the immense numbers of diverse facts which it harmonizes and explains, I venture to look upon the theory of evolution in its main features as one of the most probable hypotheses ever proposed."

Mr. Spencer, by an induction of facts never before equaled for the variety and extent of learning which they display, has shown how all those phenomena which involve questions of genesis or succession find their explanation and organizing law in Evolution. That the solar system had a nebular genesis is now, we may say, universally received by astronomers According to this theory the system had its origin out of a homogeneous and incandescent vapor, which rotating about a center passed through successive changes consequent upon a dissipation of motion in the form of heat. As the rotating mass cooled, there was integration; when this process had reached a certain stage, rings were thrown off from the more rapidly revolving equatorial regions, which gathered into planets. Here was differentiation. The central and larger portion being less condensed on account of its retained heat, formed the sun. Here we have evo-

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lution on a grand and imposing scale. The truth of the nebular theory has of late years received a most remarkable confirmation from the revelations of the spectroscope. When Galileo pointed his telescope to the planet Jupiter, and beheld his four moons revolving round their central world, the Copernican theory received a confirmation which its opponents could not withstand. In like manner, when the spectroscope was brought to the aid of astronomy, the theory of cosmic evolution received a confirmation which almost commands acceptance. Far off nebulæ yield a spectra which prove them to be incandescent gas in different stages of evolution,—embryo worlds which are now passing through the same successive phases of development as was once the case with our own system.

Geological evolution is mainly distinguished from astronomical by the fact that it is chiefly due to the disturbing influence of radiation from foreign bodies, principally the sun. The facts of geology go to prove that the earth was once a reservoir of intense heat, which produced a repulsion among its elements, so that it "was without form and void," or, in scientific language, a structureless mass with no definite arrangement and dependence among its parts. While this high temperature lasted, it must have been a time of universal tropics, so that there could have been no spring, summer, autumn and winter. Variety among the seasons arose from the loss of heat, so that the earth's "external temperature began to depend chiefly upon the supply of solar radiance." Thus the continual loss of heat producing integration, and the heat retained in the central mass producing differentiation in structure gradually developed the earth into its present variety and dependence of parts. Thus arose its internal structure, and also those systems of moving equilibrium in its water and atmosphere upon which depend its different climates and seasons. The facts and principles which now form the beautiful and imposing edifice of geology were a mere mass of materials without method or order until they found their logical relations and explanations in the guiding principles of evolution.

With regard to the application of evolution to organic phenomena, space will allow only a few brief statements. We make these more especially for the purpose of pointing out some of the misunderstandings which continually beset this aspect of the subject. Organic evolution is often spoken of by its opponents as though it were intended to set aside the idea of a Creator. Nothing can be farther from the truth. Evolution raises no question as to the ultimate origin of the world; admitting this with all its forces, physical and vital, to have sprung from a divine Creator, the question it has raised is one solely concerning the method of the divine procedure in the production of the wondrous forms of matter and life as we know them. Hence, the whole issue in organic evolution, as raised by Darwin, is one about the origin of existing species, whether these are supernatural creations by direct *fiats*, or have been developed from pre-existing species by the workings of natural causes. The prime object in his work on the "Origin of Species," as he himself states, was "to show that species had not been separately created."

A fundamental difference between the old and the new theory of biology is that while the former endeavored to explain the diverse forms of life on teleological principles, the latter regards environing relations as an essential factor in solving such problems. Between the organism and its environment there is a continual interaction which must, in the course of long ages, produce specific and well marked modifications. The law of Natural Selection, as proposed by Darwin as an explanation of the manner in which present existing species have been developed from pre-existing ones, is based on the principle of adaptive changes which organisms must undergo in order to adjust themselves to changes in environing relations. The truth of this law derives strong support from the consideration that organisms are not such fixed and immutable forms as they were formerly supposed to be. It is clearly shown that this was especially the case during geologic time when types were *fluent*, so to speak, and less subject to the law of limit, so that there was a transformation of one species into another. During the mesozoic period geology shows that there were *comprehensive* types in which fish, reptile, bird and beast seemed to flow into one another. The law of Natural Selection is not inconsistent with the operation of other causes in the development of species. Wallace, Mivart and LeConte, while assigning to this law an important sphere of action, contend for other causes, even supernatural *fiats*. Evolution is the only hypothesis which affords an explanation of the empiric principles of biology. As the undulatory theory of light is the only hypothesis capable of explaining all the facts in the case, so Evolution is the only hypothesis which has yet been offered capable of explaining the successions of species during the life-history of the earth. Evolution, having no rival theory as to the origin of species, has been almost as generally received by biologists as the undulatory theory of light has been by physicists. As to the account of the miraculous creation in the first chapter of Genesis, this sets up no rival theory against evolution, for it leaves the origin of species an open question. The continuity and succession of events implied in evolution are not inconsistent with occasional manifestations of supernatural power. This occasional manifestation of supernatural power in the form of *fiats* is all that is taught in Genesis. The entire organic world was due to three *fiats*, one for the creation of vegetable life, one for the creation of animal life, and one for the creation of man. But it is plainly implied that these miraculous *fiats* were instantaneous manifestations of divine power, while geology teaches that the development of the myriad forms of life was a long process, extending over countless ages, during which time organic species arose in an ever advancing gradation. While, then, the beginning of those long periods termed days was marked by a supernatural *fiat*, their duration was an unbroken evolution of the effects of those fiats, during which the successions of life, from species to species, went forward according to the working of natural law. There is, therefore, no reason why evolution should not be recognized as a fundamental principle of theology as well as of science, so far as the former needs to recognize any theory regarding the *method* of creation. The evo-

lution of the organic kingdom seems like a continually ascending spiral rising into ever widening cycles of multiform life, which now and then by the accumulation or *creation* of force starts forth into sudden and paroxysmal forms of development.

Evolution is now received as the working hypothesis in biology by which are settled all questions concerning organic types and classifications. Classifications in biology are no longer, as formerly, based on external and non-essential resemblances, but on essential *genetic* relationships. On this point Prof. Gray, our most eminent American botanist, says: "Taken as a working hypothesis, the doctrine of the derivation of species serves well for the co-ordination of all the facts in botany, and affords a probable and reasonable answer to a long series of questions which, without it, are totally unanswerable."

But in no department of investigation has the success of evolution in solving difficult problems been greater than in psychology. One of the great problems of psychology from Plato to the present time has been to explain the correspondence between the world of mind and the world of things. Now, if a theory is to be tested by its ability to explain questians which all others have failed to answer, then Evolution should be regarded as possessing the highest scientific value. The theory of evolution explains the intuitions or innate forms of thought in a manner so satisfactory as to make all previous efforts appear fanciful. It views the mind, not as a metaphysical entity acting in *vacuo*, but as a definite structure, an organism, eudowed with special facilities which have been moulded into their present form through a continuous interaction with environing forces. The effects thus produced by the law of heredity are transmissible, so that what was ancestral experience becomes in the individual an innate endowment of mental faculty. Hence, the correspondence between the mental faculties and the external world must be interpreted as due to the latter acting on and modifying the former in conformity with itself. Mind is thus brought within the category of organism, the fundamental law of which is Evolution; and as a complex structure due to the workings of this law, it grows and develops in conformity to surrounding forces and conditions.

In view, therefore, of the great variety of proof in support of Evolution in which all the various orders of cosmic phenomena find their unity and explanation, we think the Synthetic Philosophy may justly be regarded as the *organon* of the sciences, as indicated in the title of this essay.

It is feared that the Danish steamer Oscar Dickson, with an exploring party, has been lost in the Siberian Polar Seas. This is the Sweedish vessel which was named after Dr. Dickson, of Gothenberg, Sweeden, who equipped the last expedition of Prof. Nordenskjold.

ARCHÆOLOGY AND ANTHROPOLOGY.

SCHLIEMANN'S DISCOVERIES AT TROY.

JAMES MACALISTER.

The name of Dr. Schliemann has been so prominently before the public for a number of years that most persons know something of his eventful life and the discoveries associated with its later years. It is doubtful, however, if the magnitude of the work he has performed, and the vast importance of the results he has obtained, are generally understood. No one man has ever accomplished so much in the field of archæological research, or contributed so largely to the solution of problems which have an undying interest for all intelligent minds. With an enthusiasm and a forgetfulness of self rare among men, he has devoted his hard-earned wealth and the prime of his manhood to the elucidation of the immortal poems that have charmed and instructed the world for three thousand years; and to him more than to any other man is due the feeling of certainty with which we can now regard these poems as historical records of a period that has hitherto been regarded as purely mythical.

It is seldom that the whole life of a man stands so closely related to the achievement which has brought him honor and fame as is the case with Schliemann. Born in poverty, and receiving but a limited education, he early formed the resolution to master the poems of Homer, and to discover the city beneath whose walls the battle of the *Iliad* took place. To find Troy was the dream of his boyhood—a dream which, through all the shifting scenes of his career, never forsook him, and to the realization of which he decided, at the age of forty-four, to give up the remainder of his days and the fortune he had gathered for this purpose. While following the business which made him rich and procured him leisure, he kept the great aim of his life constantly in view, and fitted himself by the study of languages and history for the undertaking which, on retiring, he was ready to begin. In 1864 he relinquished commercial pursuits; and after five years spent in travel and in preparatory study at Paris, he repaired to the Trojan Plain to commence the excavations which have made him famous. With the exception of the time spent at Mycenæ, he has ever since pursued his researches there, carrying on extensive diggings at great expense, and seeking by various publications to make the world acquainted with the results of his labors. Altogether he has given about five years to the excavations at Troy.

The chief purpose of Dr. Schliemann's labors has been the verification of the Homeric legends concerning Troy. It was an object worthy of the noblest endeavors of his enthusiastic nature. Where did the "Sacred Ilios" stand? Is Troy a myth; or was there really a city where Priam ruled, which was conquered, despoiled, and burned by the Grecian hosts? Was the Ten Years' War, with its

mighty deeds of arms, a fiction of the poet's brain? Did Homer invent the scenes, the events, the men and women, of the *Iliad*? These are the questions which this intrepid explorer in the field of classic legend took upon himself to answer. He had a profound faith in Homer—an unwavering belief in the reality of his narrative; and the task he undertook was to prove the objective correspondence of the little corner of land in the extreme north-western corner of Asia Minor with the poetic description of the *Iliad*, and that the hill of Hissarlik is the very place where stood the "Holy City" around which was enacted the "Tale of Troy Divine."

If the reader will look at a classical map of the country around the Hellespont, he will find in Troas a point south of the strait (the actual distance is three miles) marked Novum Ilium. On modern maps this name will be changed to Hissarlik. For centuries after Homer's time, this was the accepted site of Troy. But about 200 B. C., a writer known as Demetrius of Scepsis challenged the identity of Novum Ilium with the ancient Ilios of Homer. His arguments were of the flimsiest character; but, unfortunately, his views were adopted by Strabo, the geographer, whose authority was respected till the end of the last century. It is not certain where Demetrius and Strabo placed the site, but it is supposed to have been at a place now known as Akshi Kioi (rather more than four miles in a direct line southeast of Hissarlik. In 1785, Lechevalier, a French traveler who had made a hasty examination of a portion of the Troad, put forward claims for a place called Bounarbashi as the spot where Troy had stood in the days of its strength and glory. Nearly sixty years ago an attempt was made to revive the identity of Novum Ilium with the Homeric Ilios, by Maclaren, an English writer. Since then scholars have disputed over the conflicting claims of Novum Ilium and Bounarbashi, and there is no saying how long the controversy might have continued, had not Schliemann gone to work with pickaxe and spade, and applied the sure inductions of archæological science to the settlement of the question. He has spent years in laying open the soil at both places, and has produced incontestable proofs in favor of the place which Greek tradition had asssociated with the story of the *Iliad*. Three feet below the surface of the hill at Bounarbashi he struck the solid rock, and there were neither ruins nor remains to show that any city had ever stood there. Mr. Philip Smith has said that "the theory of Lechevalier is a mere hypothesis, born from the fancy of a modern traveler, without the slightest historical or traditional foundation." To this might be added that not a single fact or principle of archæology can be quoted in support of the Frenchman's theory.

Dr. Schliemann went to work in a very different spirit, and pursued very different methods, from any of his predecessors. He organized an extensive establishment at Hissarlik, and labored with a zeal that knew no bounds. His excavations extend to a depth of 52½ feet from the surface. In penetrating to this depth he passed through a series of seven strata, differing from each other in many particulars. In his opinion these strata correspond to a succession of cities

that have arieen one above the other through long periods of time. The lowest stratum goes back to a prehistoric age which must have antedated the Trojan war by many centuries; the highest stratum was the site of the Hellenic city of Novum Ilium. It is the third stratum, thirty-three feet from the bottom and ten feet thick, which Schlieman identifies as the Homeric Ilios. Here he claims to have found the ruins of a city which answers to all the requirements of the *Iliad*, and it is to the substantiation of this claim that his book is devoted. It would be sheer presumption to think of summing up in a few lines the immense mass of facts and reasoning gathered in the eight hundred pages of the work; but we may venture to state in the briefest form the principal propositions by which the conclusion is obtained.

First—The position of the hill of Hissarlik answers nearly all the demands of the *Iliad* as to the topography and scenery of the surrounding country, in which the action of the poem is represented as taking place.

Second—The structure and arrangement of the ruins of the third stratum which have been laid bare correspond to a remarkable extent with the descriptions of the poem.

Third—The place bears the strongest evidence of having been destroyed by a great conflagration, and in this respect furnishes peculiar evidence of its identity with the city which Homer describes as having been given to the flames by the victorious Greeks.

Fourth—The ten treasures of gold and silver found in or near the principal house prove the city to have been the residence of a powerful and wealthy chief—such an one as Priam is described to be in the poem. These treasures afford good ground for the epithet "City of Gold," so frequently used.

Fifth—The archæological remains of all kinds found in such abundance are such as naturally belong to the age which can fairly be assigned to this third stratum of the excavations, and correspond with great exactness to the descriptions of the *Iliad*.

Sixth—The historical testimony, to which allusion has already been made, is strongly corroborative of the disclosures made by the excavations at Hissarlik. It is not likely that Xerxes would have visited Novum Ilium to make libations to the heroes slain in the Trojan war, or that Alexander would have come thither to offer sacrifices to Priam when on his way to the East, if the traditions which connected Novum Ilium with the Troy of Homer had not been well founded and universally believed.

It is not pretended, of course, that the topography and remains of the third city unearthed at Hissarlik correspond in every particular with the pen of Homer. It must not be forgotten that Homer deals with his matter in the large and imaginative manner of the poet. Still, the agreement is much more striking than would be suspected; and, taken together, the propositions stated above make out an overwhelming case in favor of Schliemann's views. As Professor Virchow has well said, "It is not left to our choice where we should place Ilium; therefore we

must have a place which answers to all the requirements of the poetry; therefore we are compelled to say: *Here*, upon the fortress-hill of Hissarlik—*here*, upon the ruins of the burnt City of Gold—*here was Ilium.*"

Closely connected with the problem as to where Troy stood are other questions of fascinating interest. It is but a step to the inquiry whether the persons and incidents described in the *Iliad* are to be treated as myths or regarded as historical facts. There is no room for the discussion of this question here; but we may be permitted to remark that since the publication of Dr. Schliemann's researches but few scholars of eminence have cared to speak of the *Iliad* as nothing more than a collection of poetical fictions. All, indeed, are not willing to follow Mr. Gladstone in yielding to Homer an historical authority quite equal to that of Herodotus. But that the Trojan war was an actual struggle, "some scene of that act of the warfare between Europe and Asia which made the western coast of Asia forever Greek," as Mr. Freeman puts it, is a proposition entitled by every canon of historical criticism to unqualified acceptance. The traditions woven into poetic form by Homer must have rested upon a solid basis of fact. Transformed to a very considerable extent they no doubt were by "the vision and the faculty divine" of the poet; but we cannot close our eyes to the literal exactness with which many of Homer's lines fit into the facts revealed by Schliemann. Henceforth we may have the satisfaction of feeling that Homer was not only mighty in fancy—the inspired singer of the "ways and workings of the Olympian gods"—but a trustworthy narrator of historic events. Achilles and Hector may be names invented by the poet; but we may be sure that they stand for heroes who actually engaged in deadly strife before the walls of Priam's city. We get from Professor Virchow, a scientific observer of nature, so complete an idea of the Trojan plain and the surrounding scenery, as seen from Hissarlik, that it seems almost impossible to read the *Iliad* now without realising that it is not all fiction. We can stand upon "Ilion's towers" and view Mount Ida, "rich in springs," where Zeus, the "cloud-compeller," dwelt; the heights of "woody" Samothrace, the seat of "earth-shaking" Poseidon; the "flowery mead" through which the "eddying" Scamander hurries to the sea; the Hellespontine shore where the ships of the Achæans lay beached in "double rows." We can sit in the place where Priam, with his "sage chiefs and councillors," watched

> "the glorious deeds
> Of Trojan warriors and of brass-clad Greeks."

And we can walk through the "Scæan Gates," where Hector of the "gleaming helm" took a last farewell of the "fair" Andromache. Surely these glorious memories are not all the mere fancies of a poet's mind! Surely the war of Troy must be real history! Surely this is Troy itself, dismantled and burnt by the fury of the victorious Greeks!

But there is still another question connected with Schliemann's discoveries which must not be allowed to pass unnoticed. Even if it should be granted that Troy had a real existence, and that the Ten Years' War is an historic fact, the

problem of Homer himself would still remain to be settled. Was Homer a real person? When did he live, and to what cou try did he belong? Are the Homeric poems the work of one poet or of more than one? Are the *Iliad* and the *Odyssey* by the same person? Is the *Iliad* one poem, or was it formed by the insertion of certain books in an earlier *Achilleid*? These are not new questions, and they exist quite independently of Schliemann's explorations. But these explorations throw a flood of light upon the Homeric problem. We need scarcely say that Schliemann believes in the actual existence of Homer and the substantial unity of the Homeric poems; and his researches, and the use which has been made of them by scholars, have immensely strengthened this side of the controversy. The archæological knowledge we now possess all goes to show that while Homer, to use the language of Mr. Gladstone, "was neither contemporary nor denizen of Troy," he must have been familiar with the city and its surroundings, and that he could not have been far removed in time from the events of which he sings. Dr. Schlieman is exceedingly guarded in his statements concerning the time and place of Homer; but we are inclined to think that Virchow does not speak too strongly when he says that "the *Iliad* could not have been composed by a man who had not been in the country of the *Iliad*"; that the "bard must have stood upon the hill of Hissarlik and have looked out thence over land and sea," and that "in no other way could he probably have combined so much truth to nature in his poem." And the learned professor does not believe it possible that "a poet living at a distance could have evolved out of his imagination so faithful a picture of the land and people as embodied in the *Iliad*."—*The Dial.*

AMERICAN POTTERY.

PROF. F. W. PUTNAM.

Twenty-four years ago Professor Swallow, of Missouri, explored two mounds near New Madrid, in the southeastern part of that State, from which he obtained about a hundred specimens of pottery and numerous other objects. This collection was secured by the Peabody museum of Archæology at Cambridge in 1874, and was briefly noticed in the Eighth Report of the Museum. At the time of its purchase the "Swallow Collection" was considered of great value and importance, as comparatively few objects of pottery were then known from the mounds and ancient burial places of the Southwestern States. Since then many of the mounds of Southwestern Missouri and of the adjoining portions of Arkansas have been more or less thoroughly explored, and there are now probably from fifteen to twenty thousand objects of pottery in public and private collections which were obtained from that region, and are known to the archæologists under the general term of "Missouri Pottery." Although this peculiar type of pottery has received its name from first having been found in abundance in the New Madrid region, it would be incorrect to imply that pottery of the same general character is limited to that locality; for it is also known to be more or less abun-

dant, here and there, throughout a large portion of the country drained by the central and lower Mississippi and its tributaries. Each little center in this designated territory, however, has its local peculiarities; just as we should expect would be the case in the work of a widely spread people subdivided into tribes and villages, but deriving the knowledge of the art from a common source.

A thorough acquaintance with this type of pottery, from its comparative abundance, wide distribution and peculiar forms, is of great importance in American archæology; and the Archæological Section of the St. Louis Academy has done a good work in placing within reach of all students the present elaborately illustrated memoir,* which is the first of a series on the archæology of a region that is exceedingly rich in prehistoric and early Indian remains.

The memoir is divided into two sections. In the first part W. B. Potter gives an interesting account of the position and character of the earth-works and mounds in the southeastern portion of the State of Missouri, including an important geological account of the great "Swamp Region" in which they are found. Accompanying this part of the memoir are five maps, showing the location of the old settlements on the "ridges." These settlements are surrounded by embankments and ditches, and include most of the mounds which were explored by members of the Academy.

The pottery obtained from them is described by Dr. Edward Evers in the second part of the memoir, accompanied with twenty-four lithographic plates, upon which are represented over one hundred and forty vessels of various shapes and different styles of ornamentation, which were selected for illustration from over four thousand specimens, belonging principally to the collections of the Academy, Dr. Engelmann, and Prof. Potter.

In common with the pottery from many other and widely distant nations and countries, many of the vessels from the Missouri mounds can be classed as water-bottles, bowls, dishes, and jars, and pots with or without handles. Occasionally a vessel is found which has a general resemblance to a form that is common to some other locality, and leads one to speculate on the possibility of a transmission of the form from a widely separated people, or on the possibility of the individual occurence of the same ideas, expressed by the peculiar design, among people who were far apart. This thought will probably occur to many on glancing over the illustrations in the volume, when the general resemblances between many of the Missouri vessels and those from Central America and Peru, and the early Asiatic and Egyptian forms, will be apparent; but when the vessels themselves are studied, the method of their manufacture, the peculiarities of their ornamentation, and many little technicalities, will show a far greater divergence in the art itself than is expressed by the simple occurrence of identity in form and the realistic ornamentation common to many nations during corresponding periods of development.

It is hardly necessary to state here that the Missouri pottery was made with-

*CONTRIBUTIONS TO THE ARCHÆOLOGY OF MISSOURI, by the Archæological Section of the St. Louis Academy of Science. Part I. Pottery.

out the use of the wheel, and is not glazed. Much of it is well burnt and is comparatively thin and hard. Probably the kiln was not used, and the hardening was done entirely by heating over coals or burning in an open fire. Dr. Evers mentions much of the dark pottery as simply sun dried, but a series of experiments has led me to the conclusion that this is an error, and that simple sun-dried specimens are seldom found. The dark-colored vessels are unquestionably very near the natural color of the blue clay of which they are made, but this color is not changed unless the color is subjected to considerable heat. The slight luster on the vessels was probably produced by polishing the surface with a smooth stone while the clay was soft, as is still done by many Indian tribes in America.

Much of the Missouri pottery is ornamented by waved lines, circles, and stars, and other simple and symmetrical designs, in red, white, and black; but these colors were put on after burning, with a few exceptions, and are only well preserved under favorable conditions. In some of the red vessels the color was burnt in. Common incised lines and designs, and "punch" and "nail" ornamentation, also occur.

The most important and interesting of the vessels are those that are modeled after natural forms which they faithfully represent, such as the gourd-like bottles and shell-like dishes, and those in which the design in ornamenting the vessel is to give the characteristics, if not the forms, of fishes, frogs, birds, beavers, panthers, bears, and other animals, as well as of men and women. Of such forms the plates in the memoir give many characteristic examples that are well worth a study.

In this brief notice of the work it is only intended to call the attention of the readers of the REVIEW to the first important memoir that has appeared on the as yet little known pottery of America, and to ask for it the attention which the subject demands. The time has at last come when the antiquities of our country and the remains of former Indian tribes are beginning to receive careful attention, and wild speculations and loose statements are giving way before the accurate presentation of facts. Such memoirs as the present will do much to put the knowledge of the archæology of America before the public in a proper way, and we can but offer our congratulations to the gentlemen of the St. Louis Academy who have presented a portion of the results of their explorations to the public in this modest, conscientiously written, and well-illustrated memoir. May its reception be such as to secure the publication of the other numbers of the series as proposed.—*American Art Review.*

INDIAN TRADITIONS RESPECTING THEIR ORIGIN.

T. L. LEWIS—BOLIVAR, MO.

Almost every tribe has its own peculiar idea of the "origin of man." Many of the South American Indians, as well as most of our Southwestern tribes, represent, in their traditions, their fathers as issuing from caves, springs or lakes,

which accounts for the peculiar veneration they have for springs, caves and lakes.

In Peru the natives of the valley of Xanca claim to be the descendants from a man and woman who came out of the spring of Guaribalia; those of Cuzco, that they came out of Lake Titicaca, while those of the valley of Andabayla say that they came out of Lake Socdococa. There is also a Peruvian tradition that after the flood six people came out of a cave and re-peopled the desolate earth.

The Caddoes, Ionies and Ahmandankas of Texas had a tradition that they issued from the Hot Springs of Arkansas. The Mandans and Minnetaries, on the Missouri River, say they came out of a large cavern.

The Appalachian tribes claim to have originated at an artificial mound on the Big Black River in the Natchez country.

De Smet tells us of a tradition among the Blackfeet which is romantic as it is peculiar. There are two lakes, the Lake of Men and the Lake of Women. From the one man had his origin, the other woman. Upon the first meeting of the sexes the men struck up a sharp bargain with the women, in which the latter were outwitted and reduced to perpetual drudgery. The men proposed to become their protectors on the one condition that they would assume all the household care and drudgery.

The Ute Indians tell of a beginning when the earth was covered with mist, which the Great Spirit dispersed it with the bow and arrow, and found the earth uninhabited. He then took clay, fashioned man, and set him to bake, but as it was only an experiment, the fires were not hot enough, so he came out white—a white man. The Great Spirit tried it again, with a more intense heat. Leaving him to roast a long time, he came out black—the negro. He then fashioned one with greater skill, and after the most careful baking, he came out red—the red man, the first Indian—the most perfect type of manhood.

Some others claim an animal origin, as the Toukaways of Texas, from a mole; the Lenni Lenapes or Delawares from a snail which inhabited the banks of a large river which had its source in the mountains near the rising sun. The Choctaws assert that they were originally crawfish. One day a part of the family were out enjoying the sun and were carried away and became Choctaws. The remainder are yet under the earth. Such is the general character of their traditions.

Dr. George M. Beard repeated in the New York Academy of Sciences his interesting mesmeric experiments with the patients whom he has specially trained for this purpose. The results were again most interesting and astonishing. Artificial catalepsy was produced, and each of the senses temporarily suspended at will. The experiments in the production of local anæsthesia were particularly interesting; a small spot in the face of one patient being made insensible to pain, while all the surrounding parts were abnormally sensitive.

BOTANY.

HISTORY OF THE VEGETABLE KINGDOM.

REV. L. J. TEMPLIN, HUTCHINSON, KANSAS.

[*Concluded.*]

We now approach the period in the world's history that was par excellence the age of plants, viz: the Carboniferous Age; the flora of which has been anticipated in the Devonian Age. In this last we also find anticipation of coal beds in the dark bands colored by carbonaceous matter, which are found between the strata of this age. The vegetation of the Carboniferous Age surpassed in luxuriance and grandeur all that had preceded it; and at least, in the abundance of individual plants it has never since been approached. The land was composed principally of low, marshy islands that were subject to elevation and depression at long and irregular intervals. They were consequently sometimes above the water, and at others the sea would come over and cover them. The climate was tropical in its character, and the atmosphere heavily charged with carbonic acid; on account of the absence of elevated land to cause precipitation it was constantly filled, almost, if not quite, to saturation with moisture. All these furnished conditions favorable for the production of a vegetation, so luxuriant in its abundance and so gigantic in its proportions, that it is doubtful whether the most favored localities in tropical countries of the present day can furnish a parallel. The most important plants of this age of Acrogens may be considered as belonging to five different families. Beginning with the lowest and simplest, the families are Calamites, Sigillarids, Lepidodendrids, Ferns and Conifers. The first three of these are generally classed as Lycopods and Equisetæ; but there are good reasons for considering them as distinct families. Calamites were plants with long, slender, reed-like stems either hollow or containing a pith. These stems were composed of woody structure, and with vascular tissue resembling exogenous gymnosperms. The leaves, which were narrow and pointed, were arranged in whorls around the nodes of the stem. The internodes were fluted or striated, the striæ extending only between the nodes. It is probable the equisetæ belonged here. During the coal age these grew to tree-like proportions, though at the present day they are represented in this country only by the scouring rushes that seldom rise above three feet in height.

Among the most singular and interesting plants of this age, were the Sigillarids. The Sigillaria are found as fossils in flattened trunks, roots and leaves. The trunks of these trees are fluted vertically like the Grecian Doric style of architecture. Each of these flutes has a line of sculpture running down its center varying in shape with the different species, and giving the trees a very ornate appearance. These sculpture-like markings are the scars left by the leaves, being the places where the leaves had been attached to the stem.

These trees grew to the height of 70 or even 100 feet; they probably had few large branches that were covered with long, stiff, pointed leaves. The roots, of which the soil seems to have been filled, had the peculiarity of terminating quite abruptly, as if they had been of the nature of rhizoma. These were probably the largest trees that flourished in the Carboniferous age, their remains having been found four to five feet in diameter, and with an estimated height of 95 to 100 feet. These resembled on one hand palms or cycads, and on the other they were closely allied to the lycopods. Indeed, so strong are the affinities of this for both of these families, that by some naturalists it is classed with the one, and by others it is placed with the other. The Sigillarids were among the most numerous of all the orders that flourished during this age. More than twenty species have been discovered, and extensive beds of coal appear to have been formed almost exclusively of plants belonging to this family. The Lepidodendra were great trees of the Club Moss type that grew to the height of 40 to 60 feet, and with trunks that sometimes attained to three or four feet in diameter. The typical genus, Lepidodendron, which was probably one of the largest of the family, had a bark regularly marked in a rhomboidal pattern resembling the scaly surface of a ganoid fish, from which the genus takes its name, which signifies "scale tree."

These marks which run obliquely around the stem represent the phylotaxis, and give the stem a pleasing and somewhat ornate appearance. The trees were furnished with long, spreading roots, that were calculated to fix them firmly in the soft, boggy soil in which they probably grew. In general appearance these trees resembled the modern Auricaria or Norfolk pine, or a giant club-moss. In fructification they resembled the true club-mosses, but the stem possessed a true pith, and in this respect the genus was raised far above the modern club-mosses and showed decided affinities with endogens. The most abundant family of plants of the coal age, in both individuals and species, were ferns. The *Fern* family constituted about one-third of all the plants of this age in both Europe and America. In the British coal flora, of less than 300 species of plants, 120 were ferns and 45 more were more nearly allied to ferns than to any other known family. The total number of species of plants in the coal measures of America was about 500, not less than 250, or one-half, of which are ferns. These ferns varied in size from the humble, creeping species that trailed on the ground to those of towering trees. In order to enable them to resist the force of the wind the lower part of the trunk was strengthened by having the soft, cellular tissue abundantly penetrated by bundles or buttresses of dense vascular fiber, as tough and elastic as the strongest wood. The last and highest family of vegetation that flourished during the coal measure period, and that contributed toward making up that vast accumulation of vegetable remains, the carbonization of which produced the various beds of coal of that age, is that of Gymnospermous conifers. These did not enter into the composition of coal to a very great extent as compared with the previously mentioned families, their

remains being generally in the form of logs, stumps, fruits and leaves, which are most generally embedded in the limestones and sandstones of that age. They were doubtless upland productions, and those that are preserved as fossils were probably driftwood that had been carried down by floods and buried in the alluvial deposits of that time. Though these were without doubt conifers, they bore little resemblance to modern genera and seem to have been very generalized types. They appear to have borne a considerable resemblance to the Auricaria or Norfolk pines of the present day.

Such is a very general outline of the flora of the coal period. A few facts in connection with this flora are worthy of more extended consideration. The first fact that arrests attention is the vast amount of vegetable matter that must have been produced during this age. It has been estimated that it requires not less than eight to twelve feet of vegetation to make one foot of coal, and that a vegetable production of two tons per acre per annum would, when the lighter gases—hydrogen and oxygen—are eliminated, as is always the case in forming coal, produce only one-fourth of an inch of coal in a century. At this rate it would require about 5,000 years to form one foot of coal. Now, in some localities there are beds of 40 to 50 feet of almost pure coal, while in places the aggregate of the different beds reaches 100 and even 150 feet of solid coal. This would indicate an enormous lapse of time, or a luxuriance of vegetation of which we can form no conception. Probably both these causes operated to produce these results.

The next fact to be noticed is the highly differentiated character of the flora of the carboniferous age. We have here in contemporaneous existence the Thallogens of earlier ages, the Acrogens for which this age is specially noted, and the Exogens that were more conspicuous in later times.

Though these all flourished contemporaneously, it has been assumed by some that the more highly developed forms were derived from the more simple by a process of development. But while there has been a general advance in structure of vegetable organisms, there is a lack of evidence of related successional forms that would seem to be essential to sustain such a theory. According to the evolution theory, the various types of plants should have appeared in the order of their complexity of structure: First, the Thallogens, next the Acrogens, next the Endogens, followed still later by the Exogens. And not only should they have appeared in this order of succession, but there should have been gradational forms to show the successive steps by which the lower rose to the higher forms. But such intermediate forms are not forthcoming.

The higher types appear suddenly and without any appearance of progenitors of any earlier types. The assumption that such development must have taken place during the long lapse of time that is supposed to have intervened between the different eras and of which we have no record left in the rocks, is certainly not consistent with the rules of evidence required by scientific reasoning. It is assuming that the theory must be true simply because we do not know it to be

untrue. Such a course of reasoning—which is basing our science on our ignorance instead of on our knowledge—can hardly be considered in accordance with the certainty demanded to establish a scientific truth. A third fact concerning the coal flora is, that though the most luxuriant the earth has ever produced, it was in its nature utterly unfit to minister to the wants of herbivorous animals. A few mandibulate insects may have found sustenance in the foliage, bark or wood of some of the vegetable forms of that age, but we have no evidence that any higher animal organisms ever grazed on the verdant plains or browsed in the luxuriant forests of that age specially noted for the abundance of its vegetable productions. The higher animals of this age seem to have been amphibians that probably preyed on the lower forms of animal existence. The orders of plants that prevailed at that time contribute but little to animal sustenance at the present time when herb-eating animals are so extremely abundant.

The Reptilian Age, which succeeded to the carboniferous, was also characterized by the production of extensive beds of coal, indicating a flora that in some degree would rival that of the preceding age.

Extensive coal deposits of this age are found in Eastern Virginia, North Carolina, England, Scotland, India and China. A considerable change, however, had taken place in the vegetable tribes since the coal age proper. The Lepidodendrids, Sigillarids and Calamites of the previous age had measurably or entirely disappeared, and the forest vegetation of the age of reptiles was composed principally of tree ferns, cycads and conifers. The first of these, which had formed so conspicuous a portion of the flora of the previous age, still existed in great numbers, forming near two-fifths of the whole flora. The cycads, which appear here for the first time, were a family of plants allied on one hand to the ferns and on the other to the conifers, and which, in their general appearance, resembled stunted palms. Numerous species of conifers appeared during the earlier periods of this era. The Oölitic and Jurassic periods were remarkable for the abundant gymnospermous forests that existed. As the coal measure periods were remarkable for the prevalence of acrogens, so these were noticeable for the great number and luxuriance of zymnospermous conifers. But when we reach the Cretaceous, the latest period of this era, we find a great advance in the development of vegetable organisms. A more radical change in the flora of the earth never appeared at any other period in the world's history. This period reveals a type of plants not found in any of the older rocks. Angiosperms, both dicotyls and palms, are here found in great abundance. The appearance of a cretaceous forest would have been quite modern compared with anything that had ever appeared before. Among other modern genera might have been seen oak, beech, poplar, walnut, hickory, willow, maple, dogwood, sycamore, sassafras, tulip-tree, laurel, sweet-gum, fig and myrtle. Many of these genera were represented by a considerable number of species that can boast of but one or two at the present time. Of this we find examples in the sassafras, sycamore and others. It thus appears that many of these genera are but the fragments of a much richer flora of an earlier age. When we reach the next age—the Cenozoic

or Mammalian—we find the vegetable productions still more resembling those of the present. The genera of dicotyls, palms and grasses, were the same as now, though the species were different. The indications are that a warm climate prevailed far to the north, many of the plants of that age being palms, and among the dicotyls were many, such as the magnolias, that at the present time flourish only in the warm latitudes. In Eocene times numerous species of palms flourished in Europe, while plants of the amentiferous orders, as the oak, beech, hazel, etc., were perhaps quite as abundant as at the present day.

During the Miocene period more than thirty species of palms flourished in Europe, while the country was covered, even as far north as Iceland, Lapland and Spitzbergen with evergreens such as now flourish only in the more southern parts of that continent. Much of the flora of Europe at that time closely resembled the present flora of the United States, as in the plane and buckthorn families. Many of the vegetable productions of America at that time were much the same as now, as the Sequoias or Big Trees and Redwood of California. The mildness of the climate of the higher latitudes was also evidenced by the fact that magnolias, libocedrus and taxodiums that now flourish only in the warmer climates, grew luxuriously in Greenland, also in Northern Europe. We now approach the age of Man—the Quaternary or present age—in which the changes in the vegetable kingdom were more in the introduction of new species of already existing genera, than of new genera.

I have now traced the history of the Vegetable Kingdom from the earliest dawn of its existence of which we have the slightest clew down to the present fully developed and highly differentiated flora of the world We have found that reasons exist for believing that vegetation existed at a much earlier date in the world's history than is shown by any vegetable fossils, the evidences of such existence being found, not in direct vegetable remains, but in certain facts that cannot be accounted for in the present state of knowledge on any other hypothesis. It has been seen that there has been a general upward tendency—a development of plan marking the whole progress of this history. First appeared plants of the most simple character, consisting of simple stems. These, of course, were all marine. Next, the lower cryptogamic plants appeared, followed in order by lower forms of conifers, finally culminating in the highly developed dicotyledonous flora of the present time. I have given some reasons for not accepting the theory that this constant ascension to higher and more complex organisms was the result of "Descent with Modification;" not that I have any objection to evolution in itself; I simply doubt the adequacy or legitimacy of the proofs by which it is sought to be established. The rule of development that has governed in the introduction of higher forms has been by sudden jumps from lower to higher forms, and not by *gradual modification.* In most cases of marked advance, all intermediate forms, if they ever existed, appear to have utterly perished, leaving no trace behind. To assume that they have existed and perished is to beg the whole question, and it is disconsonant with the rigid and exact methods that are and should be demanded in all scientific investigation.

XUM

GEOLOGY.

GEOLOGICAL FEATURES OF BIBLE LANDS.

PRINCIPAL J. W. DAWSON.

[We find in an Auburn paper an abstract of two of Principal Dawson's lectures at the Theological Seminary in that city upon "The Geological Features of Bible Lands." That upon the special topic, "The Geology of Egypt in Relation to the Hebrew Sojourn," is as follows:—ED.]

On the blackboard was a section illustrating the geological structure of Egypt, drawn in white chalk. Underneath this was written the following scheme:

Granite and Diorite
Crystalline Stales } (Eozoic?)
Nubian Sandstone, (Carboniferous),
Nummulitic Limestone.
Later Tertiary.
Alluvial.

The lecturer began by alluding to the sojourn of Israel in Egypt. He took the view that this lasted through the entire period of 430 years, mentioned in the Bible, as opposed to the view that the 430 years began with the departure of Abraham from Ur of the Chaldees. Then, after noticing the importance of the sojourn in Egypt, as a means of training to the chosen people, he entered upon the geographical character of Egypt, the country of the sojourn. He cited the ancient saying that "Egypt is the gift of the Nile." The narrow strip of fertile country broadening out, to the north, into the Delta, is made by the materials brought down and deposited by the great river. Apart from this, Egypt is similar, geographically, to the rest of Northern Africa.

Pointing to the large map of Egypt the lecturer called attention to the Lybian hills on the east, the Nubian hills on the west, and the valley of the Nile between them, and then took up, in order, the scheme on the blackboard. The oldest Egyptian rocks are the granite and diorite, the latter often called basalt by travelers. These are igneous and eruptive in their origin, that is, formed by the action of fire, and pushed up above their former level by eruptions. The lecturer pointed out on the map the distribution of these rocks, and filled up the places assigned to them in the section on the blackboard with little crosses marked in red chalk. He also exhibited specimens and explained the uses made of them by the Egyptians. The great obelisks, the facings of the pyramids, and other like works were made of granite, quarried at Syene, and floated down the Nile. In the geography of the country, also, the granite foundation was important. It caused the cataracts of the Nile, thus forming the limit of Egypt. The succeeding parts of the scheme on the board were treated in the same way.

This analysis was followed by a rapid sketch of the formation of the land of Egypt, first by the upheaval of the igneous rocks, then by the depositing, upon

and against these, of the successive sandstone and limestones, and afterward the formation of the later rocks and soil.

All this had much to do with the nature of the Hebrew sojourn, and with their employments and their training while in Egypt. The probable location of the land of Goshen was indicated. When the Israelites were first assigned to it, it was probably being just reclaimed by drainage and irrigation. The marshes to the north afforded pasturage for cattle, and the hills to the south for sheep. These and various other circumstances attending the sojourn, were illustrated by means of the physical characteristics of the country.

The subject of the second lecture was "The Geology of the Sinai Peninsula and its relation to the history of the Exodus." To the maps and diagrams before exhibited were added a larger geological map of the southern part of the peninsula, and cross-sections of the isthmus of Suez and Palestine. The blackboard bore a chart of geological strata, substantially like that presented for Egypt on Thursday evening.

The peninsula of Sinai, said the lecturer, having been for years comparatively unknown, is now accurately known to its whole extent, owing to the recent careful Ordnance Survey under the auspices of the English Society for the exploration of Palestine and other neighboring countries. It is a great triangle, 150 miles at its greatest breadth across the north, and 130 miles long. Its geological formations are identical with those of Egypt, though differently arranged. The mountain region of the lower part is of great physical grandeur, the great rough granite mountains rising to the height of 9,000 feet, and the valley-plains between them being 4,000 feet above the sea Thus in a very small area a wide variety of climate, of scenery and of geological structure is found. The mountains are formed of syenite granite, associated with gneiss and dolorite of the Eozoic ages, and flanked on every side by a belt of Nubian sandstone, rich in ores of copper, iron and manganese. North of this, and forming the great interior table land which reaches almost to the Mediterranean, are formations of cretaceous limestone and of Nummulite limestone of the Eocene period. The other geological formations are a broad strip of later tertiary gypsum series across the north, raised beaches of the post-pliocene on all sides of the peninsula and desert drift of modern formation in various places.

At the time of the exodus of Israel the peninsula was inhabited by three peoples: the Amalekites, nomadic, and pastoral, occupying the arid interior tableland; Egyptian miners and garrisons holding some of the western valleys of the mountains, and the Midianites, miners, and merchantmen, filling the eastern coast along the gulf of Akabah.

The lecturer then went on to speak of the route of the exodus from Egypt, the crossing of the Red Sea, etc. Mustering at Ramses, in their own "Land of Goshen," they were a host of 600,000 armed men, and with women and children must have numbered more than two millions, exclusive of the "mixed multitude," which chose to cast its lot with them. From Ramses across the isthmus of Suez three ways were possible: 1. The maritime road along the coast, be-

tween the Mediterranean and the Serbonian marsh, recently maintained by Brugsch-Bey to have been their route; 2. The direct highway across the desert to Canaan, a military road, probably garrisoned by Egyptians; and 3d. The way of the Red Sea. The third is favored alike by probability and the Biblical narrative. They turned then to the southeast, but instead of crossing above Suez, between the gulf and the bitter lakes, were Divinely directed to go further down and encamp by the sea, the mountains shutting them in on all other sides. Pharaoh endeavored to hem them in from the rear, when Divine interposition opened the path through the sea.

Of three places which have been supposed to be the place of the crossing, that just at Suez is in every respect the most probable. This miracle was in the use of natural causes, a strong northeast wind laying bare some one of the ridges of the bottom, as even now it occasionally makes the shallows fordable. That the host in the dead of night and in an awful storm were emboldened to make the passage is itself almost a miracle. Coming out of the sea, they were in what they named the Wilderness of Shur or "the wall," from the great limestone bluff 600 feet high which there confronted them. Turning to the south at the foot of it, they follow along the coast of the Gulf of Suez. Here the wells are few and the water bitter, being impregnated with carbonate of soda. At Marah the water was miraculously made sweet. They, next reach the wilderness of Sin, which they so named from its sharp stones, a hot, arid, waterless waste, the worst place of all the wandering. Here the miraculous supply of manna began, and here the great flock of migratory quails was blown to the camp. From the Wilderness of Sin they turned at right angles up the Wady Feiran, a valley rapidly rising to higher and cooler regions. Here occurred their first contact with the inhabitants of the land, the Amalekites, who held the pass against them at Rephidim, a well selected point of great strategic advantages. This the Hebrews reached after two day's march through a waterless country. Here, in their need, the water from the rock was given them. Dislodging the Amalekites after a hard struggle, two days' further march brought them to the great valley plain opposite Mt. Sinai, which the Survey has identified beyond a doubt as the only place which meets the demands of the record. Here in comparative ease and comfort, safe from attack on the rear and with communication open to the friendly Midianites, Israel spent several months; here the Law was given and the Tabernacle set up; here the military organization was perfected which prepared the people to possess the promised land. Hardly a place in the world is so well adapted for the purpose. To the suggested explanation of the awful phenomena, which attended the law-giving, as volcanic, the lecturer said that no volcanic action could have possibly taken place in Sinai during the human period. The phenomena rather resemble the thunder storms which are of such awful force and grandeur in this region. Of the whole narrative of the desert sojourn it was remarked that the exact science of the Survey confirms it at every point, and places it beyond a doubt that Exodus and Numbers are the contemporary journals of Moses, and that he knew every foot of the ground.

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THE DAKOTA GROUP.

BY CHAS. H. STERNBERG.

In 1853 Dr. Hayden discovered a number of dicotyledonous plants in a reddish and yellowish sandstone in Nebraska. This formation, lying at the base of the Cretaceous, he called No. 1, or Dakota Group. Later, in connection with Prof. Meek, he discovered the same formation in central Kansas. He found that the plants closely resembled living species of the higher types of our forest trees. Some of these plants were examined by Dr. Newberry, who found among them several genera that were exclusively Cretaceous—and more recent collections made by Profs. Mudge, Lesquereux and the writer, have proved conclusively this group to be the lowest in the Cretaceous. On the eastern margin this deposit lies on the Permian. The other formations of Mesozoic time have been swept away—or, more likely, never existed—and the Permian beds were dry land until the opening of the Cretaceous. The rocks of the Dakota Group consist of strata of red, yellow and brown sandstone, interlaid with beds of various colored clays and lignite. The sandstone is often found in thin, shaly layers. Although the formation has been supposed to be of fresh water origin, the recent discovery of marine shells has proved the contrary. The formation extends from the Gulf of Mexico through Texas, Kansas and Nebraska; touching Iowa, it continues through the British Possessions, and doubtless includes Greenland and the Arctic lands. In Kansas it is about seventy five miles wide, and extends diagonally across the State. Prof. Lesquereux published the first description of the flora of this group; and, later, his magnificent memoir on the Cretaceous Flora has given us a pretty thorough knowledge of the fossil plants. Lesquereux, in addition to his Flora, has published a review of the Cretaceous, in which he describes 26 new species, most of which I was fortunate enough to obtain in the same localities from which he obtained the material for his memoir. I think I am correct in saying that I made the first large collection of fossil plants from the Dakota. They were sent to the Smithsonian and Dr. Newberry—who, so far as I know, has never classified or figured them. They were very fine specimens, and then nearly all were new to science. I showed a number of drawings I had made to Prof. Lesquereux in 1872, who said even then a number of species were new. Since, from his own and Prof. Mudge's collections, he has obtained all the species represented in my collection—though many of his type specimens are much poorer than mine—and I lost the credit due me for my early discoveries and science lost the figured representations of some very fine plants. I must acknowledge that Prof. Lesquereux mentioned this collection in his Flora and gave me full credit for the localities I had discovered and named a number of beautiful plants in my honor. One of the earliest plants to excite general interest was the sassafras; a trilobate leaf with large midribs and well marked nerves. One of the species, *S. mudgii*, resembles the common sassafras. Nearly all the forest trees of to-day are represented in the rich Cretaceous flora. I have

discovered in the bluffs near Ft. Harker a number of species of the *aralia*. *A. quinquepartita* has five lobes, margin entire, while *A. saporteanii* has five large lobes with dentate margin—both are very fine species, and allied to our highest families of existing trees. *Aralia tripartita* (or *imperfecta*) is a smaller species with thirteen entire lobes. A number of other species have been described by Lesquereux, showing that this magnificent tree was well represented by numerous species in the Cretaceous forest. The sassafras, as I have said, was the first plant to excite interest. It is represented by a number of species—*S. mirabile* is a large leaf with three lobes, having a wavy and dentate margin; *S. cretaceum* and others are very abundant in the sandstone of Ellsworth county, Kansas. A closely allied genera is *cissites*—in fact, its species have usually gone under the genus *sassafras*. *Cissites Harkerianum* and *obtusum* are very common. The stately plane, poplar, oak, black walnut and many others left their leaves imbedded in the sandstone of the Dakota Group. One magnificent specimen I found near Ft. Harker belongs to the genus *aspidiophyllum* and species *trilobum*. I have found specimens a foot in length and breadth. One peculiarity of the species is, that the midrib is perfoliate—an ear projecting below the stem. Another species with perfoliate midrib is *Protophyllum Sternbergii*—a leaf one foot in length and six inches wide, with undulate margin. The graceful leaves of the *menispermites* and poplar are often found. The texture of the rock is so fine-grained that the midribs, nerves and outline are as finely imprinted as if done in wax. I believe I can claim the honor of being the first to obtain pine cones from this formation.

Dana says in an old manual that they are not found in the cretaceous. One beautiful cone with leaves is described in Lesquereux's Review of the Cretaceous, under the name of *Pinus quenstei*. Among the semi tropical plants is the cinnamon and fig. The common plum is also found. We have, therefore, at the opening of the cretaceous a flora rich in recent genera. Not only do lowly forms appear, but the highest families of our forest trees; each species representing a perfect tree with no known ancestors. How can we reconcile this fact with the theory of evolution, where long ages are required for the perfection of species, and where the geological record should show these transformations, step by step, from lowly forms to the perfect tree. Certainly the records show no such advances in the vegetable kingdom. But as early as the Cretaceous we find as perfect a flora as exists to-day, without even the Trias or Jura to draw from. The Dakota limestone lies on the shales and limestone of the Permian. The formation has been but little explored, and the rich returns from limited areas led us to expect many new species when the rocks are explored. The sandstone is valuable for building purposes. The Post Hospital at Fort Harker is built of thiss tone, and though it has been dismantled, and the wood work carried away, the walls still stand, and the rains of summer, and frosts and storms of winter have been unable to crumble them in ruins. Beds of lignite are found in Ellsworth county that are of great value to the inhabitants. Potters' clay is also found, as well as iron ore, aluminous shale, iron pyrites, and crystalized gypsum. The iron ore

is said to be equal to the best Swedish. The soil is rich and produces good crops of corn and wheat. The surface is undulating, and covered with a thick carpet of buffalo grass that protects the soil from denudation. We find near Fort Harker large concretionary masses of fine sandstone. They are valuable for grindstones. Some of them are 20 feet in diameter, and where they rest on soft rock that has been fashioned into rude pillars by the elements, they resemble huge mushrooms. I trust Kansas will soon organize a thorough geological survey. It is too bad that science must wait for private enterprise to develop the rich stores of animal and vegetable remains buried in the rocks of our great State. Already many rich collections have been taken out of the State to Yale College, Philadelphia, and other Eastern museums. Among the marine shells described by Prof. Meek are found *Cressatellina oblonga, Arca parallela, Yoldia microdonta, Cardium Kansensis, C. Salineus, Turbo mudgiana,* etc.

MEDICINE AND HYGIENE.

THE THERMOGRAPH: ITS EVOLUTION AND DESTINY.

A. WELLINGTON ADAMS, M. D.

[Dr. A. Wellington Adams, of Colorado Springs, has invented an apparatus for measuring the heat of the body for a given or an indefinite length of time, to which apparatus he gives the name of Thermograph. It is a very ingenious contrivance, and it is based upon the principles Breschet advocated. Medical men have long been plodding on with the ordinary medical thermometer, the best of them recording but one application to the body. It must be evident to every one in the medical profession, as well as those out of it, that any instrument that can so record the temperature that the medical man can enter the sick room, day or night, and see what the temperature of the body has been for any hour, half, or quarter hour of the twenty-four, we repeat, it must be evident, that such an instrument must be of incalculable value to mankind. This Thermograph widens the field of the diagnostician and allows him to prognosticate more surely.

There has long been a need for something which would register accurately the rise and fall of temperature during sickness, and the present system is sadly limited by the many imperfections and the very narrow range of its application, and we are glad of this addition to the mechanical appliances of medicine. In dealing with the force, electricity, Dr. Adams found many obstacles; the greatest were the proper condition of the conductive carbon under pressure and the friction of the apparatus, the last by no means being the least. Also, by his studying the principles laid down by Breschet and Becquerel, Pere et Fils, he has succeeded in giving to the world his Thermograph, an instrument which will be a very valuable auxiliary to physiological, therapeutical and pathological investigation. Dr.

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Adams in the first part of his article discusses the subject in general, and we will give the remainder in his own words.—R. W. B.]

My researches now remained *in statu quo* for some time, when one day, in the course of conversation with Dr. J. Harry Thompson, of Washington, D. C., he suggested the utilization of the newly discovered property of carbon to vary its conductivity under different degrees of pressure.

I immediately availed myself of this suggestion, developing the instrument as now perfected and illustrated in figs. 4 and 5. This is the thermometer proper

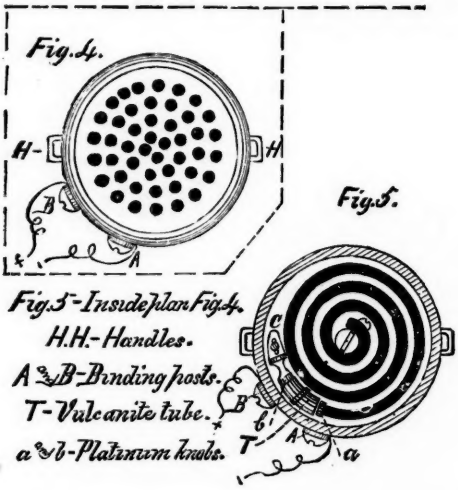

Fig. 3 - Inside plan Fig. 4.
H.H. - Handles.
A & B - Binding posts.
T - Vulcanite tube.
a & b - Platinum knobs.

or responding portion of the instrument, and consists of a spiral spring made of two *lamellæ* of brass and steel respectively, soldered together, the brass occupying the outer side. Of course this spring expands uniformly with equal increments of heat, and the brass, the most expansible of the two metals, will, upon a rise of temperature, give the platinum knob (a), attached to the free end of the spring, a concentric twist. In this way we produce a varying pressure upon the contents of the vulcanite tube (T), against which the platinum knob (a) impinges.

The other end of the substance contained in the hard-rubber tube (T) has for its abutment the platinum knob (b) attached to the hard-rubber bracket (C). The whole, as seen in fig. 4, is inclosed in a perforated German-silver case, with rounded edges, and having an external diameter of but 1¼ inches.

The binding-post (A), fig. 4, is in electrical communication with the platinum knob (a), and the binding post (B) is in electrical communication with the platinum knob (b). When the apparatus is introduced into an electric circuit, by attaching the two poles to the two binding-posts, the current enters through one and emerges at the other, passing in its course through the substance in the vulcanite tube (T). The two little handles (H) (H) are intended as a means of securing

the instrument in its proper position in the axilla. The composition used in the vulcanite tube (T) may be either a solid stick of baked lamp-black, a series of thin carbon discs with intervening ones of silver, or a powder made of plumbago, gas-carbon and silver, finely divided. After receiving a communication from Thomas A. Edison in regard to this matter, I commenced a series of experiments to determine the most suitable composition for this purpose, and the best results were obtained from the powder already referred to. The salient feature of this instrument is the changing of its electrical resistance with pressure, and the ratio of these changes, moreover, corresponding exactly with the pressure, the latter, in turn, being dependent upon and in unison with the rise and fall of temperature.

Here, then, was the true solution, for, by subjecting this instrument to varying degrees of temperature, the resistance of the powder would vary in precise accordance with the pressure exerted by the uniform expansion of the spiral spring under equal increments of heat, and consequently a proportionate variation would be produced in the strength of the current. The latter would thus possess all the characteristics of the heat waves, and by its reaction through the medium of some electro-magnetic piece of mechanism yet to be devised, these might be transferred to our movable surface, in the form of a sinuous line, whose rising and falling inflections would give a graphic representation of them.

Now, that I had satisfactorily reduced this portion of the problem, the next in order was the devising that part of the instrument intended for recording such variations as the other branch might be subjected to. This, I assure you, was no easy task, but one requiring a mint of patience and tedious application. For, first—it must be simple; second—there must be established a permanent relationship between the first and second branches of the instrument, in other words, there must exist throughout a strict interdependence; third—in order that the electro-motive force required might be reduced as much as possible, it must be delicate; fourth—to render the latter possible, friction must be practically reduced to a minimum. To carry you through the almost endless and varied experiments necessary in developing means for meeting these indications would be as tiresome as it would be unnecessary. Hence, I shall confine myself to the result only.

If a number of coils of insulated wire be wound around a hollow reel, there is formed what is known to electricians as a *helix*. If this is now placed in an electric circuit and a current passed through its convolutions, it is temporarily constituted a magnet, the two ends forming the poles; so that it may be said to possess all the properties of a permanent magnet during the passage of the current. Moreover, if such a helix, mounted in a vertical position in such a way that an iron rod can be introduced into it from below, be connected with a battery, the iron rod will be at once drawn up into it and be sustained oscillating in its axis, even though the rod may weigh considerable.

The depth the iron rod enters will also depend entirely upon the strength of the current and the amount of resistance offered by the iron rod. This principle

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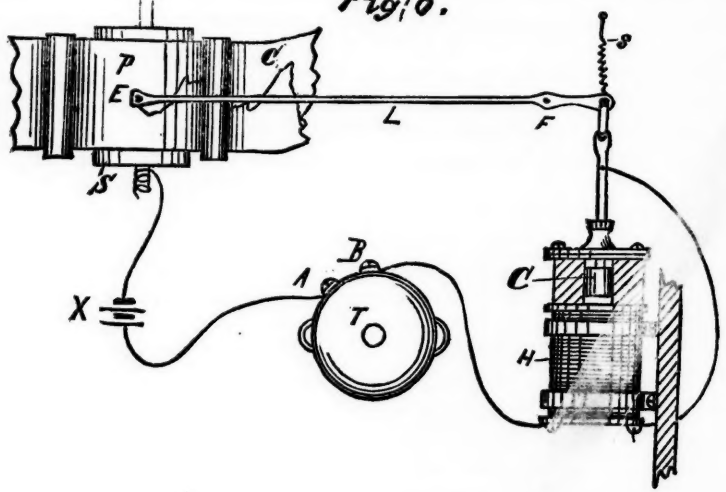
is well known in physics as the "axial electro-magnetic force," and in it I found what I sought, namely—a combination of delicacy and strength in the proper proportions. A diagramatical illustration of its application may be seen in fig. 6,

Fig. 6.



where H represents a helix of peculiar construction applied to the purpose in hand; C is a soft iron tube in connection with the short end of the lever (L); P represents the movable surface or strip of paper; F, the fulcrum of the lever, and E its marker or stylus; T, the thermometer proper introduced into the circuit; X, the battery; c, the curve, and S, the brass drum over which the strip of paper (P) moves.

Having comprehended the principles, the action of this combination is obvious. If an electric current passes through the helix (H), the core (C) will be drawn into said helix, carrying with it the short end of the lever (L), to which it is attached. This movement naturally causes the marking end of the lever to make a still longer excursion in the opposite direction. Upon breaking the circuit, the attractive power of the helix is abolished, and the counter-action of the spring (s) returns the lever to its normal position.

The depth to which the core (C) is drawn into the helix (H) being dependent upon the strength of the current passing through the coils of wire, the excursions of the tracer or lever will also be great or small, according as the current is weak or strong.

The lever (L) is delicately made, and its fulcrum provided with jewel mountings. Its short end is connected with the core (C) by means of a universal joint, while its longer end has inserted in it a silver stylus reaching to the surface of the traveling paper. The latter moves over a brass drum forming a portion of the

circuit. The strip of paper passing over the brass cylinder, having been saturated with a solution of chloride of sodium, pyrogallic acid, and ferrocyanide of potassium, the instrument is complete.

When this combination is in operation, a current of electricity will pass from one pole of the battery to the binding-post (A) of the thermometer proper, through the substance in the vulcanite tube to emerge at binding post (B); thence through the helix to the lever, along this to the silver stylus; thence through the moistened paper and brass cylinder to the other pole of the battery—thus completing the circuit. Upon the application of varying degrees of heat to the thermometer proper, the resistance the current meets with during its course will be varied in precise accordance with the various changes of temperature. This waxing and waning current will now pass through the helix, and by the latter's peculiar action produce to and fro motions in the lever, passing, at the same time, through the lever and chemically prepared paper, and producing as it passes a double chemical decomposition upon the paper; one of which decompositions renders the development of friction, during the movements of the lever, so slight as to be imperceptible; the second decomposition producing a change in color upon the paper, corresponding to the movements of the stylus, and affecting no larger surface than it covers, thus obviating the additional friction accompanying the use of an ordinary marker.

From this description you will understand that the lever is moved backward and forward by a difference in the attractive power exerted by the helix, this in turn being dependent upon the strength of the current, which has already passed through the thermometer proper, and there been moulded into electric waves corresponding to the heat waves; the motion of the lever being facilitated by the lubricating action of the current, as the result of one of the chemical decompositions during its passage through the chemicaily moistened paper; while the other decomposition causes a discoloration, and thus produces a mark corresponding in outline to the movements of the lever. This mark will, therefore, form an irregular line, whose sinuosities will give a graphic representation of the heat variations. This apparatus is extremely sensitive and can be made to record 1-100 of a degree.

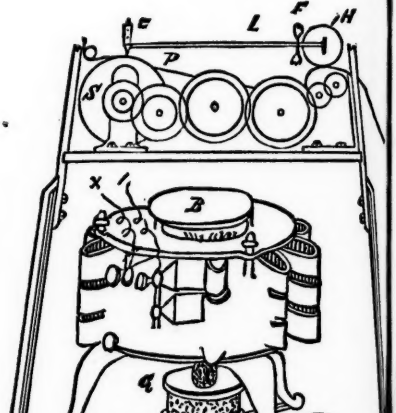
Now, after marking upon our strip of paper the minimum and maximum points representing respectively 90° and 110°, it becomes a very easy matter to determine the degree of heat represented by any point lying within this range. This is accomplished by dividing the intervening space into any number of equal parts, when any one of these divisions will represent a degree or any part of a degree, according to the number of divisions. These horizontal lines may be placed at such distances from each other as to represent 1-10 of a degree. Having provided the traveling paper with a uniform speed, it also becomes an easy matter to determine the time represented by any given distance upon its surface; for, supposing a certain amount of paper passes a given point in the instrument in one hour, to determine the amount passing the same point in five minutes, it is

only necessary to draw vertical lines dividing this distance into twelve equal parts, each one of these will then represent five minutes.

After determining upon the principles it became very easy to work up the details that would place the instrument in a convenient form for manufacture and use. These may be seen, as applied, in figs. 7 and 8. Fig. 7 is a front elevation of the complete thermograph.

Fig: 7.

Fig: 8.



It consists of a cast-iron case having two departments, one for the recording mechanism and actuating clock movement, the other for the battery. In the upper part of the front there is a circular depression for the reception of the thermometer proper or perceiving portion of the instrument when not in use.

This is held in place by means of two little catches, one on either side, as seen in the figure. On both sides of this are the binding-posts for the reception of the wires leading from the thermometer proper, when the latter is in position in the axilla. The open work in the lower portion is intended for the ingress of air and egress of gases. Fig. 8 is an interior elevation with the front removed; above is seen the recording mechanism, and below the thermo-electric battery. This form of battery gives a continuous and unvarying current, requires no cleaning or recharging, and costs but little to run, hence it is the most available source from which to derive the current; the heat for operating it may be supplied by either an alcohol lamp or gas-burner. Not only is it possible with this instrument

to procure a continuous curve denoting the constant febrile condition of a subject, but, with the addition of certain accessories now in process of construction, and as suggested by Prof. Mayer, of the University of Technology, Hoboken, and Dr. Toner, of Washington, we may be able to procure, on the same strip of paper, at the same time and under similar conditions, a sphygmographic and a respiratory curve; thus enabling pathologists, therapeutists, physiologists, and, in fact, general practitioners, to study the inter-relationship of these three cardinal symptoms under various modifying circumstances. These are the *possibilities*, but when we drift into the *probabilities*, we see in prospective the addition of that which will also furnish a moisture curve. Of the advantages of the graphic method as applied to medicine, I need hardly speak. It already promises for medicine what it has accomplished in physics.

Every physicist adores such familiar names as Leon Scott and Dr. Clarence Blake, to whom we are indebted for the application of the graphic method to the science of acoustics, through the medium of the phonautographs invented by themselves.

To the experimental therapeutist this instrument is of incalculable value, as affording a means of determining the precise character of the temperature changes under the administration of various therapeutic agents in different sized doses and modes of exhibition.

The experimental physiologist will find in it that which will materially facilitate accurate observation in his field. And the advantages accruing from its application in pathological investigations, and the possibility of thus elucidating hitherto obscure phenomena, must be patent to every one. An instrument of so much value as an aid to observations in these three important branches of scientific medicine, needs no further lauding; but I cannot draw my paper to a close without setting forth the mode of application and the advantages attending its use in every day practice.

Take, for example, a suspected case of typhoid fever, experience and experimentation with the thermograph having already revealed a characteristic ***minor*** wave curve for typhoid fever. The physician is summoned. Upon arriving he applies his thermograph in the following manner: First, the perceiving portion, as seen in fig. 4, is fastened in the axilla by means of two elastic bands attached to the handles H H, one passing around the trunk, the other over the shoulder. Next, two fine and flexible silk covered wires are led from the binding-posts A B, fig. 4, to the binding posts B B, of fig. 7, the latter having been previously placed upon a stand at the head of the patient's bed.

These wires, of course, are of sufficient length to admit of any degree of motion on the part of the patient without interfering with the position of the recorder. The instrument will now be ready for use, and, upon starting the battery, it will continue in operation for any desired number of days, with little or no attention outside of winding and replenishing with new rolls of paper.

The first benefit to be derived from its use in such a case, consists in the

ability to determine upon a diagnosis much earlier than would ordinarily be possible; second—the physician is furnished with a permanent record of the condition of his patient from hour to hour and day to day; third—the slightest modification or variation by reason of an exposure, the exhibition of prescribed remedies at given hours, or the ingestion of prescribed food during the day, will be revealed to the physician when he makes his evening visit, thus affording him from time to time, a more definite idea of the immediate effect, good or bad, of his treatment; fourth—it will give warning of danger from collapse during the crisis before it could be detected in any other way; fifth—the physician is provided with a means of leaving more definite directions with the attendant or nurse, e. g. he will be able to say that "should the curve assume such or such a character, or the line rise to this or that point, you may discontinue this, that, or the other remedy, and proceed to exhibit *this*, according to the directions; or, should such and such a thing take place, it will indicate an emergency calling for this, that, or the other measure."

The science of meteorology, also, will find in the thermograph an instrument it has long felt the need of. Never before has there been invented an instrument capable of furnishing a curve representing the constant temperature of the atmosphere. To be sure, there are two or three instruments in the possession of the United States Weather Department at Washington, constructed upon an entirely different principle, which automatically produce a continuous curve, but the latter is only by reason of the velocity with which the cylinder revolves; besides, they are of an exceedingly complicated nature, cumbersome, and *very* expensive.

The simplicity and inexpensiveness (it will cost about $50) of the thermograph, place it within the reach of almost every physician, and will enable the United States Weather Department to furnish one or more of them to every one of its sub-stations.

This, gentlemen, is the instrument I have chosen to dignify with the title of *Thermograph*, and which I have lately placed in the hands of Aloe & Hernstein to manufacture for the use of the medical profession.

With its introduction, I predict the dawn of a new era in medicine, marked by progress equal to that accompanying the introduction of the sphygmograph, myograph, cardiograph, and other important instruments of a similar character.

—*Rocky Mountain Medical Review.*

FOR CHILBLAINS.

The following formula for Dr. Valentine Mott's Remedy is given in the "Proceedings of the Medical Society in the County of Kings:"

℞ Beef's gall	4	ounces.
Ol. terebinth	4	"
Spts. vini rect. 90 per cent.	1½	"
Tinct. opii	1	"

Another formula for the same affection is:

℞ Beef brine	1	pint.
Potassæ nitratis	2	drachms.
Aquæ ammoniæ	3	ounces.

GEOGRAPHICAL.

THE HOWGATE EXPEDITION TO LADY FRANKLIN BAY.

[The following Report of the Board appointed to consider Captain Howgate's plan and preparations for his second Polar Expedition, shows what extreme care was taken in the selection of a proper vessel and in all the details connected with the fitting out of the expedition.—EDITOR.]

A Board of Officers and men of experience in Arctic matters was convened at the Signal office in Washington D. C., May 27, 1880, by direction of the chief Signal Officer, to consider and report of a "Memorandum of plan of Arctic work," submitted by Captain Howgate in connection with the proposed expedition to Lady Franklin Bay.

The Board reported as follows:

1. With respect to the provisions and fuel for the steamer *Gulnare*, and the advisability of having a surgeon for its return trip, the Board is of the opinion that these matters should be left to the discretion of the Navy Department.

2. Mr. H. C. Chester, a member of the Board, who accompanied the *Polaris* Expedition, and who is now superintending the fitting out of the *Gulnare*, states that it is the best adapted for the purposes designed of any vessel that has entered the Arctic seas.

3. The permanent party to remain at the station near Lady Franklin Bay, to be composed of three commissioned officers and twenty-five men, appears sufficiently large. These will be available for scientific work—three officers, one surgeon, one astronomer, one photographer, and three sergeants of the Signal Corps. A portion of the scientific work to be performed has already been provided for by a previous Board.

4. It is understood by the Board that the discovery and development of new whaling grounds will be incidental to the duties of exploration.

5. There is little reason to anticipate any danger to the permanent station; it is to be provisioned for two years or more. The *Polaris* left abundant stores on the opposite side of the channel, distant from Lady Franklin Bay some thirty or thirty-five miles; also the English Expedition, under Nares, left at Cape Hawk "a large quantity of biscuit."

6. The providing for the safety of sledge and traveling parties will, of necessity, have to be left to the discretion of the officer commanding the expedition. Tents are the only shelter for such parties that can well be transported, but such parties will build igloes, or snow houses, when the materials are at hand.

7. The means of transportation proposed—two whale boats, one steam yawl, six dog sledges, and thirty dogs—are considered ample.

8. The detailing of selected enlisted men for the body of the expedition promises many advantages. Of the men already selected, two have been sea-

men, four are accustomed to the use of the oar, one is a fair carpenter, and two are rough carpenters.

9. The members of the Board having had Arctic experience in the latitude of Lady Franklin Bay consider the quarters provided sufficient in capacity and comfort for the party proposed.

10. The clothing suggested appears to be sufficient in quantity and adapted to the climate.

11. The arrangements for heating and cooking appear adequate.

An abundant supply of oil for lighting for two years has been provided.

The surgeon of the expedition states that his requisition for medical stores will be sufficient for any anticipated emergency.

For scientific investigation more spare instruments should, if practicable, be provided.

QUARTERS.—A frame house, 21 by 65 inside size, with double walls, 18 inches apart, is ready for shipment, and will accommodate the whole party comfortably. This house is built after the model of those used in the Hudson Bay Territory by the company, and is, therefore, assumed to be suitable, both as to size, style and comfort.

For moving parties four wall tents with flies, and twelve A tents complete, have been provided, and will be sufficient.

CLOTHING.—Boots, stockings, mittens, sheepskins for clothing, and sleeping bags in sufficient quantity for three years' supply is on hand ready for shipment. There is still needed a supply of overcoats, blankets and drawers, which can be supplied by the Quartermaster's Department within ten days from the date of requisition.

Twenty suits of sealskin or deerskin will be obtained at Rigolette, on the coast of Labrador, in accordance with previous arrangements. If for any cause the clothing is not ready at that point, it can be obtained at Disco, and is not absolutely essential, although it should be procured if practicable.

MEANS OF TRANSPORTATION.—Two (2) whale boats, (to be got on the N. E. coast). One (1) steam yawl, (now ready). Four dog sledges, (now ready at Rigolette, Labrador). Thirty (30) dogs, expected to be ready at Rigolette, Labrador; if not ready, can be got on the Greenland coast, at Proven or Upernavik).

FOOD.—Two years' supply, as per list, already in the hands of the Secretary of War, and which, having been prepared with the assistance of Captain Wm. Kennedy, Dr. John Rae, and other Arctic explorers, is believed to be complete.

The pemmican, which is the only item not procurable from the Commissary Department, is now in Washington, ready for shipment.

Requisitions for all the other provisions have already been submitted to the Secretary of War for approval.

FUEL AND HEATING.—Coal to be used as fuel, and the supply to be ob-

tained on the spot, from the vein discovered by the English expedition, necessary tools for getting out the coal have been provided, under the advice of the manager of some Pennsylvania coal mines. The vein of coal must be critically examined before the vessel leaves the party, in order that a proper supply may be left from the ship's stores if that on shore is impracticable.

Four stoves, two cooking and two heating, have been secured, and with all their necessary furniture, are packed ready for shipment.

LIGHT.—A large supply of lamps and lanterns of various sizes and kinds have been secured, with sufficient carbon-oil to serve for one full year.

A full list of medicines, with surgical and medical apparatus, has been prepared by the surgeon, and is ready to submit for the approval of the Secretary of War.

Reading matter has been contributed in abundance, and is ready for shipment

Surveying apparatus and marine chronometers on hand. Other apparatus can be ready within ten days.

ORDNANCE STORES.—Six (6) Springfield rifles. Six (6) shot-guns. Six (6) revolvers, with necessary ammunition, and 1,000 pounds of blasting powder have been secured, and are ready for shipment.

Miscellaneous apparatus includes signaling outfit complete for four stations, including candle-bombs, heliographs, etc., etc. Eight (8) telephones. Four (4) call bells. Ten (10) miles No. 15 wire, plain. Four (4) sets telegraph instruments. Thirty (30) cells battery, Eagles. 500 pounds blue-stone and such other small items as are needed to put up two or more telegraph offices.

Vessel to leave Washington not later than June 1st and to proceed under sail to St. Johns, N. F., where she will stop for coal, ice pilot, and any other items of supplies that may be needed.

From St. Johns she will go to Rigolette, where the sledges, dogs, and the twenty suits of clothing will be taken on board. It is probable that two half breed hunters will be ready here to join the party, as partial arrangements for their services were made last year.

From Rigolette the vessel will proceed to Disco, using steam only when necessary.

At Disco the coal bunkers will be refilled, either from the Danish stores or from the supply left by the *Polaris*, if that has not been consumed. The vessel should leave Disco with her coal bunkers filled, and as much more coal stowed on board as can be provided for.

From Disco to Lady Franklin Bay the only stops other than those caused by ice or other causes incident to navigation will be at the several Danish settlements of Proven, Uppernavik and Tessieusak, for dogs and dog food, if these have not previously been secured. Arriving at Lady Franklin Bay the permanent party will be landed and the cargo discharged with as little delay as practicable, as near the mouth of Watercourse Creek and the coal vein as it is practicable for the vessel to get.

As before stated, the quality and accessibility of the coal-vein will be examined, and if found satisfactory, it will not be necessary to leave any of the vessel's coal; otherwise, a year's supply—say 60 tons, will be left.

The *Gulnare* should not leave the station at Lady Franklin Bay until at least one year's supply of fuel has been obtained from the coal mine in that vicinity, or if this cannot be obtained, at least sixty (60) tons should be left from the ship's supply.

In any event the *Gulnare* should not be permitted to proceed on its return trip until the officers of the ship and of the party shall have certified in writing as to the suitability and fitness of the supplies and the apparent safety of the station, a copy of which certificate shall be brought back in the vessel.

It is also thought that some point should be selected during the ship's journey northward, where supplies should be left in 1882, if a relief ship could not by that year reach Lady Franklin Bay.

The Board is of the opinion that there should not be an increase in the arms now provided.

If all the arrangements of the plan proposed by Capt. Howgate be faithfully carried out, it would appear that proper precautions and safeguards have been provided to secure the safety of the Arctic Expedition, and to promise reasonable success in the attainment of the objects for which the expedition was organized.

Special suggestions in writing by Mr. Bryan, of this Board, and by Sergt. O. T. Sherman, of the Signal Corps, accompany these proceedings.

J. P. STORY. H. C. CHESTER.
A. W. GREELY. OCTAVE PAVY.
R. W. D. BRYAN.

THE HOWGATE EXPEDITION TO LADY FRANKLIN BAY.

OUTLINE OF SCIENTIFIC WORK.

The following plan for astronomical, metereological, and magnetic work at Lady Franklin Bay and other stations in high latitudes, was prepared by Capt. Howgate, Lieut. Story and Professor Abbe, of the Signal Office, in compliance with official instructions from the Department:

I.—MAGNETIC WORK AT FIXED STATIONS.—The outfit necessary for this work is considered to be as follows:

1. The Unifilar Declinometer, or the complete Magnetometer, as made by Fauth & Co., Washington, D. C., No. 70 of their catalogue, and costs about $400. This should have a set of very light needles, as well as the ordinary heavy ones, and is to be used for absolute and differential observations of declination.

2. A Kew Dip Circle to be used for dip and total intensity. It should be compared with similar observations made at Washington, at the Coast Survey

Magnetic Observatory, before starting on the expedition, and also after the return.

3. A Ship's Chronometer very accurately rated in Mean Time. With these instruments, the declination dip and total intensity should be determined on the 1st and 15th of each month.

The differential observations of declination are to be made with the Declinometer every day, three times a day, namely, at 7 a. m., 3 p. m., and 11 p. m., Washington time, and are to be made by taking readings at the first second of every minute, for fifteen minutes, namely from 7 a. m. to 7:15 a. m; 3 p. m. to 3:15 p. m.; 11 p. m. to 11:15 p. m.

By this means there will be secured observations simultaneously with the Signal Service Meteorological observations, and also simultaneously with the magnetic observations made at the observatories that pursue the Göttingen plan. By these means, also, data will be obtained for showing the rapid fluctuations to which needles are subject when an auroral disturbance is taking place.

The term days will be the 1st and 15th of each month, on which days, besides the fifteen minutes' observations previously provided for, there will be made a special set of readings of the Declinometer, at the beginning of each five minutes throughout the entire day, or if this be not possible, then, at least, in groups of two hours and fifteen minutes, viz.: from 6:15 a. m. to 8:15 a. m.; 2 p. m. to 4:15 p. m.; 10 p. m. to 12:15 a. m., Washington time.

II.—The Magnetic Observations at Temporary Stations By Traveling Parties.—The outfit for this class of work will be as follows for each party:

1. Cassella Astronomical Theodolite, as made by Fauth & Co., No. 60 of catalogue, which is considered decidedly preferable to the English make, it having 3-inch circles, and costing $150 with its stand. This instrument can be used for determination of latitude, time, longitude, azimuth and magnetic declination.

2. Kew Dip Circle, small size, to be used for determination of magnetic dip and intensity.

3. Two Pocket Chronometers, kept accurately rated on mean time.

With these instruments the absolute dip and intensity should be determined at every convenient stopping place, and if the party stays long at any station, these elements should be determined each day, and especially at 7 a. m., 3 p. m. and 11 p. m., Washington time, as before directed for the permanent station. The term day observations should be also kept up by the traveling parties, if they happen to be at convenient stations on the 1st and 15th of the month.

Observers will have to be especially instructed in the use of the instruments. The best works of reference are:

Riddell's Magnetic Instructions, London, 1844. Admiralty Manual of Scientific Inquiry, 1871. Admiralty Arctic Manual, 1875. Walker's Terrestrial and Cosmical Magnetism, 1866. Coast Survey Special Instructions.

The form for records may be those given by Riddell, with such modifications as the modern construction of magnetic instruments may demand.

III.—METEOROLOGICAL OBSERVATIONS.—These should be made at least three times daily, at the exact hours of simultaneous observations, 7 a. m., 3 p. m., and 11 p. m., Washington time; and, unless absolutely impossible intermediate observations should be made every two or four hours, the complete series being at 1, 3, 5, 7, 9 and 11 a. m, and 1 3, 5, 7, 9 and 11 p. m. In case that self-registering apparatus is suyplied, the personal observations of those items that are so recorded need be made only at 7 a. m., 3 p. m. and 11 p. m. The thermometers and barometers should be of superior quality, and in general the instruments and methods of instruction embodied in the Instructions to Observer Sergeants of the Signal Corps should be followed. The outfit should be that of a first-class Signal Service Station, to which should be added the following supplementary instruments:

1. Self-Recording Barometer. 2. Self-Recording Thermometers. Regnault's Dew Point Apparatus. 4. Vacuum Solar Radiation Thermometers. 5. Hick's Terrestial Radiation Thermometors. 6. Heiss' Apparatus for Convergence of Auroral Beams. 7. A number of small india rubber balloons and apparatus for filling them, for ascertaining air currents, heights of clouds, etc.

Special instructions for the use of these instruments are scarcely necessary, on account of their simplicity; but, in order to call attention to many minor points, the observer should be furnished with extra copies of the following works:

Signal Service Instructions. Admiralty Manual of Scientific Inquiry. Admiralty Arctic Manual. Instructions to the Florence Expedition. Pickering's Physical Manipulation. Kohlransch's Physical Measurements. Everett's Translation of Deschanel's Natural Philosophy. Loomis' Meteorology. Buchans' Meteorology. Kaemtz' Meteorology.

Special attention is called to the importance of accurate observations at every station of the minute details of auroral phenomena and their changes, (see Stoke in the Arctic Manual, page 19,) which should be recorded carefully by diagrams and otherwise, together with the hour, minute and second of the phenomena.

IV.—ASTRONOMICAL OBSERVATIONS.—The only astronomical observations recommended as imperative are those for determining latitude, longitude and time. Such observations must be made every day at sea, and when traveling. The position of the central station must be determined by observations made at every favorable opportunity, until there have been accumulated at least ten independent determinations of latitude and longitude, so that the mean of all may be reasonably accurate. The determination of the errors of the chronometers must be made whenever practicable and the resulting corrections immediately deduced, so that the meteorological and magnetic observers may be able to maintain strict simultaneity in their observations.

As in all the physical and astronomical observations to be made, the same chronometers must be used, and as these latter are most conveniently kept on Greenwich time, it is recommended that all records and daily reckonings should,

without exception, be kept on Greenwich mean time; that is to say, in the corrected chronometer time.

It will thus happen that the simultaneous S. A. M. observations will be made as follows: 7 *h.* 0 *m.* 0 *s.* A. M., Washington time; 12 *h.* 8 *m.* 12.09 *s.* P. M., Greenwich time; 12 *h.* 47 *m.* 58.33 *s.* P. M., Göttingen time. The only apparatus recommended as outfit for parties is as follows:

I.—FOR TRAVELING PARTIES; FOR EACH PARTY: 1. Pistar & Martin's Prismatic Circle, which is considered preferable to the sextant, as it measures larger angles, which are oftentimes imperatively needed. The instruments should be constructed with special reference to use at very low temperatures.

2. Mercurial, or Artificial Horizon. 3. Two Pocket Chronometers for central station.

1st. The Cassella Astronomical Theodolite, as made by Fauth, as before enumerated under the head of "Magnetic Work." If this cannot be furnished, then the astronomical transit, capable of being used in any meridian, should be furnished; but this is more cumbersome to be set up, and is not recommended. Either instrument should be especially constructed for use at very low temperatures.

2d. Pistar's & Martin's Prismatic Circle, or if not possible, the Sextant constructed by Fauth, No. 73 of this catalogue, price, $110.

3d. The Artificial Horizons.

4th. Four Box Chronometers.

With these pieces of apparatus it is believed that a skillful observer can determine his position with all needed accuracy. The instructions to be followed in the use of these instruments are to be found in Chauvenet's Practical Astronomy, Nautical Almanac (U. S.), Bowditch's 5-figure Logarithm Tables.

In the determination of the errors of sextants and circles, reference should be made to the Memoir by Harkness, in the U. S. Naval Observation for 1869, Appendix I, page 51.

On the use of the portable Transit, the Zenith Telescope, etc., if provided, see Hilgard and others, in the Coast Survey volumes of observations.

The only purely astronomical work to which it is recommended that special attention be given will consist in observing the phenomena of shooting stars.

In this class of work the principal point is the determination of the radiating point for each group of shooting stars that may be seen, for which purpose the observer needs to be supplied with a number of the blank charts of stars, prepared by Prof. H. A. Newton, or with an equivalent planisphere.

EXTRA OBSERVATIONS. It is considered that the following important subjects should be recommended to the observer's attention, viz:

1. Magnetic Earth Currents. (See Nipher on Earth Currents, etc.)
2. Tides. (Earthquakes and earth tremors of the feeblest kind.)
3. Pendulum Experiments.
4. Atmospheric Electricity.

XUM

5. Polarization of the Light of the Atmosphere.
6. Spectroscopical observations of the Aurora and Shooting Stars.
7. Soundings to determine depths of Sea and Channel.
8. Temperature of the Sea Water.
9. Density of the Sea Water.
10. Thickness of the Sea Ice, the Ice Floes and the Icebergs.
11. The preservation of specimens of air in hermetically sealed flasks for future analysis at home.
12. The melting of large quantities of freshly fallen snow, and preservation of the resulting atmospheric and meteoric dust for future microscopical examination.
13. Triangulation and charting of coast lines in the immediate vicinity of the station, the location of mountains, etc., for which a simple plane table might be provided, and a tape line for measuring base lines.

COMPLEMENT OF MEN.—It is recommended that a chief observer and four assistant observers be detailed to carry out the astronomical and meteorological and magnetic observations herein provided for, and such miscellaneous work as they are able to attend to.

The chief should be especially familiar with the astronomical and magnetic work, and be able to instruct observers in their duties.

ASTRONOMY.

ASTRONOMICAL NOTES FOR MARCH, 1881.

BY W. W. ALEXANDER, KANSAS CITY, MO.

The sun during this month will appear to be moving north at a very fast rate, the daily rate being about 0.7 of its own diameter. On the 20th, at 5 h. a. m., its center passes the equator and also enters the first sign of the zodiac, and spring commences. Mercury, for the first and second days, will show in the west for a few minutes after sunset. On the 11th it will be in conjunction with the sun, after which it will rise before the sun and cannot be seen before the end of the month.

Venus, during this month, shines with great brilliancy in the western sky for about three hours after sunset. It attains its maximum brilliancy on the 27th, after which it will gradually approach the sun, still increasing in apparent size, but decreasing in brilliancy. Its apparent diameter on the 1st is 26″, on the 31st

41″. It is in conjunction with Saturn on the 1st, being north of that planet 5° 29″.

Mars will show for a short time before sunrise in the southeast, but being quite small is hard to find.

Jupiter will still adorn the western sky after sunset. It is gradually approaching Saturn, but will not be in conjunction with it during this month.

Saturn sets a short time after Jupiter; its rings are opening out to view, but it is too near the sun to be observed to advantage.

Uranus is favorably situated for observation, being in the constellation Leo, the Lion. It passes the meridian on the 4th, at midnight.

Neptune on the 22d will be 7° 9′ south of Venus.

The Moon, on the evening of the 3d, will approach very near to Venus, being within less than its own diameter of that planet at the time of its setting.

Position of the Constellations on the 14th, at 6 h. 30 m. in the Evening.

Auriga, the Charioteer, occupies the zenith. In this constellation is situated the bright star Capella, now a short distance northwest of the zenith.

The Milky Way spans the celestial vault like an arch of nebulous light, resting on the horizon in the north northwest and south southeast, and passes through the zenith.

Cygnus, the Swan, is sinking below the horizon where the Milky Way rests upon it in the north northwest. It has nearly disappeared from view. Following the Milky Way we come to Cepheus, the King, and then to Cassiopea, the Lady, in her chair. Next come Perseus and Auriga in the zenith. Continuing in the same path toward the south southeast, we will touch the eastern edge of Taurus, the Bull. It may be recognized by the Pleiades, or Seven Stars, as the group is commonly called. There are only six stars in the group visible to ordinary eyes. An eye which is good enough to see seven will be likely to see four others—eleven in all. A telescope of moderate power will show from fifty to sixty. Another group in this constellation is the Hyades, the principal stars of which are in the form of the letter V, one part of the V being formed by Aldebaran, a red star of nearly the first magnitude.

Gemini, the Twins, lies east of Taurus, across the Milky Way. The brightest stars in this constellation are Castor and Pollux. Castor, the most northern and western of the two, is a double star when viewed with a telescope of moderate power.

Cancer, the Crab, lies east of Gemini. It contains no bright star. The only remarkable object within its confines is Præsepe, a group of stars too faint to be seen singly with the naked eye, and only appears as a spot of milky light.

Keeping on along the milky way toward the south southeast, we will pass along the western edge of Canis Minor and through Monoceros and by the eastern edge of Canis Major, which contains Sirius, the brightest star in the heavens. A number of bright stars south and southeast of Sirius belong to this constellation, making it one of great brilliancy.

THE LICK OBSERVATORY TELESCOPE.

The trustees of the Lick Observatory have finally closed the contract for the optical part of their great telescope. There has been considerable doubt whether a refractor or an enormous reflector would be selected, but the decision is in favor of the former. The object glass is to be three feet in diameter, and the Clarks of Cambridge, Mass., are to make it for $50,000. The mounting of the instrument is not yet provided for. Proposals will be obtained from the principal instrument makers of Europe and this country. Probably the mechanical part of the instrument will cost as much as the optical. It may be three years before the telescope is finished. If the instrument proves successful, it will be the most efficient ever pointed at the heavens. Its power will exceed that of the Pulkowa glass by forty-four per centum, and it will be almost twice as powerful as the great telescope at Washington, which at present is the best of its kind.—*Scientific American.*

METEOROLOGY.

CLOUDS—LIGHTNING.

PROF. S. A. MAXWELL.

Clouds and lightning stand in relation to one another as cause and effect, therefore, in the proper consideration of the former subject, more or less mention of the latter must also be made.

"Lightning consists of an electrical discharge between cloud and cloud, or between a cloud and the earth, and sometimes between the upper and lower parts of the same cloud." Such is the definition given by Prof. Henry to that wonderful electrical phenomenon, so often accompanying storms in the temperate and torrid regions of the earth—a phenomenon of such common occurrence as scarcely to need a definition, and yet so peculiar in its nature and action as to remain, even yet, to a certain extent unknown and unexplained. The discovery of the identity of lightning and atmospheric electricity was due to the genius of Franklin, who, more than any other philosopher of the eighteenth century, contributed valuable additions to science by his tireless researches and novel experiments.

The electric spark in its passage through the air may be viewed under different conditions: hence arise those different names,—sheet-lightning, heat-lightning, chain-lightning, etc. If the spark is hidden by clouds, as it generally is during a storm, and a part of its light is reflected from the under side of the cloud, people call it sheet lightning. If seen during the serenity of a warm summer night, gilding the corrugated edges of a far-distant storm cloud, or flashing from an apparently cloudless horizon, with gleams like the aurora—then, people say it is

heat-lightning. Lastly, if it breaks suddenly from the base of the threatening cloud, and spans instantaneously with a jagged chain of blinding fire the intervening space to the earth, then, it is denominated chain-lightning. Now, in truth, these three forms of lightning are identical, the diverse appearances which they present being due entirely to external conditions.

Sometimes there occurs a form known as arborescent lightning. This is produced when a spark of electricity passing along the horizontal base of a cloud suddenly divides into several trunks, and these, sub-dividing again and again, produce the representation of a tree, with limbs interlacing one another in a network of fire. This form in its perfection is rarely witnessed. On the evening of August 6, 1870, a most magnificent exhibition of this species of lightning occurred. Hundreds of glittering sparks, originating from one, darted along the base of the storm-cloud, after the rain had passed. The aggregate length of the different ramifications of this single flash must have exceeded 150 miles! What is remarkable about this form of lightning is its comparatively slow movement. The duration of the flash on this occasion amounted to as much as two seconds; and, according to Arago, a flash of lightning requires only 1-288,000 part of a second to pass from a cloud to the earth, supposing the distance to be a mile. Another remarkable example of arborescent lightning occurred in June, 1870. In this instance, the storm was coming up from the west, though the "fan-cloud" had already extended far to the east. Suddenly, far in the west, almost down to the horizon, in fact, the electricity originated, and, passing eastward along the cloud in numerous diverging and ramifying lines, finally terminated in the outlying borders of the cloud, not less than *sixty miles* from its starting point. The extent of this flash was greater than any other on record, so far as I know, being nearly five times greater than any noted by either Arago or Flammarion. The rumbling of the thunder continued in the west for fully *four minutes* after the flash, and no subsequent flash occurring, the sound must have been the result of this most remarkable discharge. The flash must have extended at least fifteen miles to the east of the point of observation, and forty-eight to the west of it. No rain was falling at the time, and none fell until an hour afterward, and then but very little. This was the finest exhibition of Nature's fireworks that I have ever witnessed: the surpassing brilliancy of the flash and the prolonged detonations of the thunder combined to produce an effect of astonishing beauty and grandeur.

I will not speak of the so-called *globular* lightning, as I believe it never appeared in reality, but only as the product of an excited imagination; nor will I make but a s ngle remark concerning St. Elmo's fire, that peculiar, lambent light which is sometimes seen on church spires. This fire, resembling phosphorescent light, sometimes plays lightly over the surface of depending projections of a storm-cloud. This phenomenon was particularly noticeable during a storm on the evening of June 7, 1874.

Lightning sometimes appears of a brilliant white color, and at other times of

a purple or rose-colored tint. Lieut. Arthur mentions red, and also blue lightning, in his account of the Barbadoes hurricane of 1780. It has been determined that when the cloud floats comparatively near the earth the lightning is white, and when occuring at great elevations the flash is of a reddish or purple hue. The colored tints are evidently due to the rarity of the air; for the same effects are produced when an electric spark is made to pass through the air of a partially-exhausted receiver.

A certain modern philosopher says: "It is strange how strongly some errors retain their hold on the minds of men;" and the tenacious property of error is illustrated in the persistence with which some meteorologists uphold the theory that the rumblings and detonations of thunder are successive echoes reflected from the clouds.

Now, as every one knows, the lightning passing through the atmosphere, moves in broken, zigzag lines, so that, in one part of its course it may be going either *toward* or *from* us, and in another in a line at right angles or obliquely to its former direction. From every point of its course the sound of thunder proceeds. Now the velocity of sound is about 1,000 feet per second. Let us suppose a portion of the lightning's track 2,000 feet in length lies in a line, the more distant extremity of which is 2,000 feet farther from us than the other, then will the report of the thunder be two seconds sounding in our ears; while, on the other hand, should the discharge occur in a line at right angles to this one, the report would be of but an instant's duration—the vibrations reaching us from all points of the line during a single second. It is obvious, therefore, that in the former case, the intensity of the sound would be but half as great as in the latter. The different conditions of distance, direction, and intensity of the electric discharge are sufficient to account for nearly all the modifications of the voice of the thunder, which we inhabitants of the plains ever hear. In mountainous districts there are frequently echoes from mountain sides; and this is an effect most natural, but the idea that thunder is echoed from walls of vapor, like the clouds, is little short of the absurd—at any rate those should not entertain the idea who believe that the sound of *thunder* can penetrate but twice as far as that of a base drum.

In some of our text-books on Physical Geography, it is stated that thunder is never heard at a distance of more than *ten* miles. The truth is, thunder is not generally heard until the storm is within forty miles of the observer's locality; but it may be heard from one hundred to one hundred and fifty miles, if the conditions are favorable. When the top of the storm-cloud is about ten degrees above the horizon, it is then some one hundred and fifty miles distant. If the weather is very warm, it may be even more than this. If it is moving in the direction of the observer it will reach his locality within from four to six hours, since these storms move, as a general thing, from twenty-five to forty miles per hour. Some storms, however, move much more rapidly than this. One occurring in May, 1873, reached Dubuque, Ia., at 10.00 A. M., Morrison, Ill., at 11, and Ottawa, Ill., at noon.

When the Mineral Point tornado occurred, May 23d, 1878, the summit of the cloud, viewed from this locality, was about fourteen degrees above the horizon, and thunder was distinctly heard—distance about eighty miles. On the same evening, lightning flashes blazed constantly from a cloud about ten degrees high, directly in the east. The storm was raging at the time in the vicinity of Chicago, and the thunder was distinctly audible. This storm had passed over Whiteside county (Illinois), during the afternoon, and was accompanied with terrific thunder.

In the month of June, 1867, during a protracted drouth, a shower came up one night accompanied with considerable electricity. It passed on to the eastward, and, at sunrise next morning, the corrugated edges of the thunder-cloud projected slightly above the horizon. No other clouds were visible in the heavens; yet thunder was distinctly heard several times, and even after the cloud had entirely disappeared. This is sufficient proof, with what has gone before, that thunder *can* be heard even o*ne hundred and fifty miles.* In the remarkable case here noted, a light breeze from the east, combined with certain other conditions, rendered the phenomenon possible. But yet, our school-book authors lay it down as a fixed law that thunder can be heard but *ten* miles! They do not make the least allowance for varying conditions. They do not take into consideration the fact that certain conditions of moisture of the air, either more or less, have their modifying effects; nor do they seem to know that when the soil is parched from long-coutinued drouth, it then serves as a ready transmitter of sound.

The height to which a thunder-cloud ascends sometimes exceeds six miles. When five and a half miles high, it can readily be seen 200 miles.

[*To be Continued*]

MEAN ITALIAN THERMOMETER READINGS.

FURNISHED BY ERMINE CASE, JR.

			MILAN.	FLORENCE.	ROME.	NAPLES.
Saturday,	Dec.	4, 1880 . .	38° F.	47°	59°	62°
"	"	11, 1880 . .	42°	50°	55°	63°
"	"	18, 1880 . .	44°	43°	50°	49°
"	"	25, 1880 . .	42°	48°	50°	51°
"	Jan.	1, 1881 . .	50°	52°	58°	61°
"	"	8, 1881 . .	44°	49°	55°	52°
"	"	15, 1881 . .	38°	44°	45°	51°

METEOROLOGICAL OBSERVATIONS AT WASHBURN COLLEGE, TOPEKA, KANSAS.

BY PROF. J. T. LOVEWELL.

The last eleven days of January were milder than the first twenty, which were reported last month, but the average temperature was only 20°. The lowest temperature of this decade was 2° above zero, and the average of minima was 11.6°. The first decade of February was warmer, the average of minima being 20.5° above zero and the mean temperature 28.8°. The last decade of this report, which closed Feb. 20th, shows that another cold term has prevailed, and reports from many quarters indicate that the storms have been almost beyond precedent in their extent and severity. There had been no sleighing in Topeka until the 11th of February, when a snow storm began that lasted more than 24 hours. From noon on the 11th to noon on the 12th the wind traveled 1129 miles; direction from the northwest. This distance is greater by more than 100 miles than any previous record since our anemometer was set up, last May. The velocity was upwards of 50 m. per hour much of the time. Following this were several days of exceedingly cold weather—the minimum on the 15th being 9° below zero, and on the 16th 11° below zero. On the 19th it was 6° below zero. Another snow storm occurred on the 14th, and still another on the 17th. The total depth of snow at any one time on the prairie, where not drifted nor blown off, was seven or eight inches. There have been many parhelia of great brilliancy, both morning and evening. The lowest barometer, 28.59, accompanied the rain storm of the 5th. In the second decade the N. and N. W. winds have prevailed, and, as usual, the barometer has been higher.

The following table gives these results by decades:

RECORDS DEDUCED FROM AVERAGES OF DAILY OBSERVATIONS.

	Jan. 20th to 31st.	Feb. 1st to 11th.	Feb. 10th to 20th	Mean.
TEMPERATURE.				
Min.	11.6	20.5	3.0	11.7
Max.	31.9	37 8	22.4	30.7
Mean of Max and Min.	21.8	29 1	12.7	21.2
Range.	20 3	17 0	19.4	18 9
7 a. m.	15 0	21 8	6 5	15 4
2 p. m.	24.8	38 8	18.7	25 4
9 p. m.	20.1	28.9	12.0	20 4
Mean	20.0	28.8	12.4	20.4
REL. HUMIDITY.				
7 a. m.	..	.86	..	..
2 p. m.	..	.81	..	..
9 p. m.	..	.85	..	..
Mean	..	.84	..	..
PRESSURE, sea-level, 32° F.				
7 a. m.	29.00	28.85	29.08	29 01
2 p. m.	29.00	28.83	29 06	28 99
9 p. m.	29 11	28.84	29 09	29 01
Mean	29.10	28.84	29 08	29.01
WIND.				
Miles Traveled	3,955	3,656	4,771	..
RAIN AND SNOW.				
Inches melted	..	1.6	1.0	2.6

DUST AND FOG.—BENEFICIAL EFFECTS OF SMOKE.

Mr. John Aitken recently read a paper before the Royal Society of Edinburg on the origin of fogs, mists and clouds. From a great number of experiments with moist air at different temperatures, to determine the conditions which produce condensation of water vapor, he concludes that whenever water vapor condenses in the atmosphere, it always does so on some solid nucles; that dust particles in the air form the nuclei on which the vapor condenses; that if there were no dust there would be no fogs, no clouds, no mists, and probably no rain; and that the supersaturated air would convert every object on the surface of the earth into a condenser on which it would deposit as dew; lastly, that our breath, when it becomes visible on a frosty morning, and every puff of steam, as it escapes into the air from an engine, show the impure and dusty state of the atmosphere. These results have been verified at temperatures as low as 14° Fah., at which, however, there was little cloudiness produced, owing to the small amount of vapor in air so cold. The sources of this dust are many and various; for instance, finely ground stone from the surface of the earth, the ash from exploded meteorites, and living germs. Mr. Aitken showed experimentally that, by simply heating any substance, such as a piece of glass, iron or wood, a fume of solid particles was given off, which, when carried along with pure air into a receiver, gave rise to a dense fog mixed with steam. So delicate is this test that the hundredth of a grain of iron wire will, when heated, produce a distinct haziness in the receiver. By far the most active source of these fog-producing particles is, however, the smoke and sulphur given off by our coal fires; and as even gas grates will not prevent the emission of these particles, Mr. Aitken thinks it is hopeless to expect that London, and other large cities wherein such fuel is used, can ever be free from fogs. However, inasmuch as more perfect combustion will prevent the discharge of soot flakes, these fogs may be rendered whiter, purer, and therefore more wholesome, by the use of gas grates, such as that recomended by Dr. Siemens. Mr. Aitken also drew attention to the deodorizing and antiseptic powers of smoke and sulphur, which, he thinks, probably operate beneficially in killing the deadly germs and disinfecting the foul smells which cling about the stagnant air of fogs, and suggests caution lest, by suppressing smoke, we substitue a greater evil for a lesser one.—*Scientific American.*

BOOK NOTICES.

NATURAL SCIENCE AND RELIGION, by Asa Gray. pp. 111, octavo. Chas. Scribner's Sons, N. Y., 1880, $1.50.

This little work is made up of two lectures delivered by Prof. Asa Gray to the Theological School of Yale College; the first upon Scientific Beliefs, and the

second upon The Relations of Scientific to Religious Belief; and, since whatever this eminent naturalist contributes to the literature of science carries with it indisputable force and weight, it is unnecessary to say that they comprise the sum of what is known and believed by the best and most profound thinkers and experimenters in natural science and biology. His vast experience and skilled observations give him a position among scientists that few Americans occupy, and these lectures are read by old and young, creationists and evolutionists, with respect and confidence.

In the first lecture he traces the rise and abandonment of numerous beliefs; as that plants and animals are composed of different ultimate materials, whereas the essential oneness of the two kingdoms of organic nature is now a new article of scientific creed; the idea that the characteristic features of an animal were a mouth and a stomach, whereas it is now known that entozoa feed like rhizophytes and turbellarias and their relatives have no alimentary canal, the food taken by what answers to mouth passing as directly into the general tissue as does the material which a parasitic root imbibes from its host or an ordinary root from the soil; more recently, even the faculty of automatic movement is believed to belong to certain vegetables instead of being a special attribute of animals only.

The hypotheses of natural selection, origin of species, etc., are all taken up in their turn and explained in the light of the most modern discoveries, and their errors as well as their established facts clearly and fairly pointed out.

In the second lecture the distinguished and venerable author considers the attitude that thoughtful men and Christian believers should take respecting the scientific beliefs of the present day and how they stand related to beliefs of another order. In reference to Darwinism, which he declares to be entirely and clearly distinct from monistic and agnostic philosophy, he says:—"As theists we are not debarred from the supposition of supernatural organization, mediate or immediate. But suppose the facts suggest and inferentially warrant the conclusion that the course of natural history has been along an unbroken line; that—account for it or not—the origin of the kinds of plants and animals comes to stand on the same footings as the rest of nature. As this is the complete outcome of Darwinian evolution, it has to be met and considered." Christian theists "should not denounce it as atheistical or as practical atheism or as absurd," but give it the most complete investigation from the highest summits of scientific knowledge and research.

As before stated, there is no work on this subject more deserving of our studious and respectful examination.

HISTORY OF THE CHRISTIAN RELIGION TO THE YEAR 200. By Charles B. Waite, A. M.; pp. 455, 8 vo. Chicago; C. V. Waite & Co., 1881. For sale by M. H. Dickinson. $2.50.

The author of this work claims that his intent to publish it was formed after ascertaining facts and arriving at conclusions which appeared of great importance,

and which had never before been made fully known. He also assumes that it will be found the most complete record of the events connected with the Christian religion during the first two centuries which has ever been presented to the public. Whether these assumptions are fully borne out is possibly questionable, but that the work is the result of extensive reading and study, both of ancient and modern writers, and therefore well worth the examination and investigation of all readers, is unquestionable.

The book is divided into six periods. First, The Apostolic age, A. D. 30 to A. D. 80; second, the Apostolic Fathers, A. D. 80 to 120; third, the Three Apochryphal Gospels, A. D. 120 to 130; fourth, Forty Years of Christian Writers, A. D. 130 to 170, fifth, the Four Canonical Gospels, A. D. 170 to 185; sixth, close of the Second Century, A. D. 185 to 200.

The first statement that attracts attention is that the gospels of the first century, with the exception of the epistles of Paul, the one epistle of Clement of Rome, a few legends and tradition, etc., are lost; also the great body of the Christian literature of the second century has been destroyed. Later, the author states, in a review of the third and fourth periods, that in the whole mass of Christian literature cited by him, including the writings of twenty-six Christian authors, besides others of note, there is not to be found a single mention of the canonical gospels; not a reference to Matthew, Mark, Luke or John, as the author of a gospel. Still later, he states, as a result of his investigation, that "no evidence is found of the existence, in the first century, of either of the following doctrines: the immaculate conception, the miracles of Christ or his material resurrection. Finally, he declares that, notwithstanding all these absences and failures in what are usually regarded as authoritative writers and doctrines, the divine teachings of Christ, "unlike the books referred to, can be traced back to well authenticated records of the first century."

Giving Mr. Waite all credit for laborious overhauling of authorities among early and later writers, and accepting his copious quotations as correct, and even allowing that his motives and purposes in the investigations he has made were pure and in the interest of exact history, we yet fail to be convinced that he has had access to better authorities or has read them to better effect than the thousands of scholars who have preceded him, who, doubtless, were actuated by as lofty motives in their researches, and who, doubtless, were as honest in their conclusions, though differing so widely from his own.

Mr. Waite fixes the date of the canonical gospels approximately thus: Luke, A. D. 170: Mark, 175; John, 178; Matthew, 180. It seems impossible that such writers as Origen and Irenæus, whose testimony shows that Matthew's gospel was written about A. D. 58 to 60, should be so far mi taken; while the internal evidence of Mark's gospel (xiii-13, 24, 33), proves that it written before the destruction of Jerusalem. Luke's gospel is known to have been in use before A. D. 120, and the internal evidence (Acts i, 1), proves that it was written before the Acts, which, since the latest time actually mentioned in the latter is the period during which Paul lived at Rome, must have been before the year 63. John's gospel

was written later, probably during his sojourn at Ephesus, in A. D. 66, or perhaps as late as 78. Scholars of the most undoubted erudition and fairness, after the most laborious and careful research, have agreed upon these dates, which have thus far withstood all efforts to materially change them.

Many other statements of Mr. Waite are in direct conflict with the ordinarily accepted beliefs of the Christian world, and many of the authorities relied upon by him are rejected by other scholars; but, as we have before said, his book shows the expenditure of laborious examination of many authors, and will be an interesting study for all classes of readers.

CHAPTERS FROM THE PHYSICAL HISTORY OF THE EARTH. By Arthur Nicols F. G. S., F. R. G. S.; pp. 281, 12 mo.; Harper & Bros., New York; For Sale by Kansas City Book and News Co.; $1.50.

The object of the author of this work in adding another to the long list of geological text-books, is to bring the information we have on the subject to a focus and direct it to the elucidation of the physical and biological history of our planet. The work is divided into two parts, Geology and Palæontology, each comprising six chapters on the appropriate subjects which are treated ably and comprehensively. The Palæontological part will be found especially full and valuable, since in that department it is possible to present new facts and discoveries, and advance the new theories growing out of them. The last chapter, that on Fossil man, sets forth fully the Monogenistic and Polygenistic theories; man's position on the earth, zoölogically considered; his structure and relationships with lower animals; growth of speech, etc., etc., with an account of the very latest discoveries of human fossil remains, and the opinions of the most scientific men of the present day regarding man's antiquity.

One marked improvement in this book over most geological works is, that in place of the old engravings that have been handed down from the days of Hitchcock, a number of new ones are introduced to illustrate the text. This will be appreciated at least by all middle aged, or elderly readers, to whom the others have long since become more familiar even than "household words."

CURIOUS MYTHS OF THE MIDDLE AGES: By S. Baring-Gould, M. A.; pp. 453, 12 mo. Boston: Roberts Brothers, 1880. For sale by M. H. Dickinson, $1.50.

Among the mediæval myths described and explained in this volume are those of the Wandering Jew; Prester John; The Divining Rod; The Seven Sleepers of Ephesus; William Tell; Anti-Christ and Pope Joan; The Man in the Moon; St. George; The Fortunate Isles, and many more; all of which are handled familiarly and skillfully by the author. He has selected myths of whose origin and history very little is really known by most readers, although their titles are

well known to all. In doing this work he has laid under obligations the mass of the reading public, who are also indebted to the publishers for their part of the work.

SPANISH SELF-TAUGHT. By Franz Thimm; pp. 83, 12 mo.; Kansas City Book and News Co., 1880; 25 cents.

This will be found a very useful hand-book to the people of the West, so many of whom have business and social relations with those of Old and New Mexico, where the Spanish language is almost universally spoken. It consists of a grammar and a reader, with English pronunciation and translation of every word, phrase, and sentence; so that by it alone a stranger can make himself understood by a native wherever the Spanish language is spoken, or written.

OTHER PUBLICATIONS RECEIVED.

Transactions of the Wisconsin Academy of Sciences, Arts and Letters. Vol. I 1870–2, Vol. II 1873–4, Vol. III 1875–6, Vol. IV 1876–77. Proceedings of the Boston Society of Natural History; Vol. XIX. Part 1, October, 1876, to March, 1877; Part 2, March, 1877, to May, 1877; Part 3, May, 1877, to March, 1878; Part 4, March–April, 1878. Vol. XX. Part 1, May to November, 1878; Part 2, November, 1878, to April, 1879; Part 3, April, 1879, to January, 1880. Archæological Explorations of the Literary and Scientific Society of Madisonville, Ohio. Part 1, 1878–9; Part 2, September 1 to December 31, 1879; Part 3, January to June 30, 1880. Proceedings of the Iowa Academy of Sciences, 1875–80. Forest and Forestry, from Report of State Board of Agriculture of 1880, by Thos. Meehan; On the Timber Line of High Mountains, from Proceedings of the Academy of Natural Sciences of Philadelphia, 1880, by Thos. Meehan. The Geology of Central and Western Minnesota, Preliminary Report of Warren Upham, Assistant State Geologist, 1879; The Succession of Glacial Deposits of New England, by Warren Upham. The Kindergarten Messenger and the New Education, Syracuse, N. Y., 1881, $1.00 per annum; Hardwicke's Science Gossip, January, 1881, London, 5d. Proceedings of the Poughkeepsie Society of Natural Science, October, 1879, to July, 1880. Quarterly Report of the Kansas State Board of Agriculture, for the quarter ending December 31, 1880, J. K. Hudson, Secretary. Circular (No. 4) of Information of the Bureau of Education, Rural School Architecture, with Illustrations; Circular No. 5, English Rural Schools.

XUM

SCIENTIFIC MISCELLANY.

DEEP SEA DREDGING.

In the opinion of Prof. A. E. Verrill of Yale College, the recent deep-sea dredging expedition off the coast of Rhode Island, on the edge of the Gulf Stream, under the auspices of the United States Fish Commission, proved the most successful ever sent out by this or any other country. In three days more specimens were obtained than by any other expedition in as many months. In deed, the English expedition on the Challenger, which was at work deep-sea dredging for five years continuously, did not accomplish more or get a larger collection.

The dredging was done from seventy-five to one hundred and fifteen miles south of Newport, in the region known on the charts as Block Island soundings, the depth of the water being from one-quarter to three-quarters of a mile. The specially constructed steamer Fish Hawk, fitted up with the most approved scientific appliances, was used, and the expedition was under the direct charge of Prof. Baird of Washington. The ground was especially favorable. A peculiar beam trawl was used for scraping the bottom of the ocean. It was a net forty or fifty feet long. The mouth of it was spread open by an oak beam fifteen feet long and six inches in diameter. The beam rested upon heavy iron runners, to keep the net-work bag about two feet off of the bottom. The lower side of the mouth of the net was formed of a receding rope, weighted with lead. This rope dragged along the bottom and scraped the shell-fish, shells and what not into the net. Fish swimming at that depth were also scooped in, and once inside they were entangled in pockets that prevented their escaping.

This trawl would be thrown out and drawn along behind the steamer, making a swath half a mile long and twelve or fifteen feet wide. Then a powerful hoisting engine would be set to work and the trawl and its contents hoisted aboard the steamer. As many as four thousand pounds weight of stuff would be taken from the bottom of the ocean each time the trawl was hoisted. Two barrels of alcohol a day were used in preserving rare specimens. To put them in shape will be the work of weeks. To thoroughly arrange and classify the thousands of specimens obtained, will occupy the commission all winter. Most of this work will be done by Prof. Verrill and his assistants.

Eighteen species of fish were caught heretofore unknown and undescribed, besides others known to Greenland and Northern Europe, but not to our coast; also a wonderful variety of crabs, shrimp and lobster-like creatures, some of them very handsome, and forty species of them entirely new. One hundred and fifty-five different kinds of shells, one hundred and fifteen of them not before known on this part of the coast, fifty-five not known as inhabitants of American waters, and thirty wholly unknown to scientists heretofore, were obtained. In addition, two new kinds of devil-fish, one about a foot long; two hundred specimens of a

new and pretty squid, and twenty new kinds of star-fish were taken. Of these star-fish thousands of specimens were netted, some of exceeding beauty. Quite a number of new species of corals were caught, some of them being brought up by the bushel. Of fan coral some beautiful specimens were obtained. Hundreds of sea anemones, brilliantly colored, some of them measuring a foot across, delighted the eyes of the men of science. One strange discovery was a worm inhabiting a quill like a goose-quill. The quills were about a foot long, and soon after being taken out of the water grew so hard that they could be and were used for pens. They stood up in the mud at the bottom of the sea. The worms inside were opal-colored, and when taken out of their strange tenements glistened and presented a rather pretty appearance, so far as color was concerned. They were raked up by thousands, and none of the scientific men ever heard of them before.

The discovery was made that the tilefish is plentier than the cod. A Glouces ter fisherman last winter hauled in the first tilefish. Since then few have been caught. Prof. Verrill, however, caught three with a perpendicular trawl line. On opening their stomachs he found therein some of the rare crustaceæ that abounded thereabout, and he knew it was their feeding ground. He is satisfied that they are plentier there in season than codfish off Block Island. One of the fish caught weighed fifty pounds. The tilefish, as described by Prof. Verrill, is a magnificent fish of a light, yellow-brown color, shaped like a sea-bass, and spotted all over with yellow. It is fine eating, and he is convinced that it is destined to become a favorite market fish, now that it is known where it can be readily caught.

All of the fish caught by the dredges have gone to the headquarters of the commission in Washington. The other specimens came here in many boxes a few days ago, and the work of arranging them is now being pushed forward. As many as one hundred series of the various specimens will be made up and dis tributed among the museums of the country, the first choice going to the National Museum at Washington, the second to the Peabody Museum here, the third to the museum at Cambridge, and so on. A complete and detailed report will also be made by the commission.

The records of the temperature at different depths were always made with great care. At a depth of from 100 to 142½ fathoms the temperature was usually from 51° to 53° Fahrenheit. From 142½ to 325 fathoms it was from 42° to 43°, and at 500 fathoms it was 40°. The pressure at 500 fathoms or over was very great—sufficient to crush and press together the wood that incased the thermometer until it was a shapeless mass, and to so press the rope used to lower the instrument, that it came up hardened and squeezed together until it resembled a bar of metal.

In the nine years the Fish Commission has been established it has dredged in 2,000 localities (both shallow and deep waters), between Long Island Sound and Halifax, and out as far as 200 miles; but never before did they have such good luck as last month on the Fish Hawk.—*N. Y. Sun.*

XUM

A LOST CITY.

GOUR, THE RUINED AND FORGOTTEN CAPITAL OF BENGAL.

Among the marked peculiarities of Anglo-Indians is one which we have never heard fully explained. As a rule, they know nothing about India. They are not interested in it, and do not study it, do not take even the trouble to see the wonderful things of which the country is full. We should like to know how many Anglo-Bengalees know anything of the marvelous city of which the name stands at the head of this article; Gour, the ruined capital of Bengal, the Ganga Regia of Ptolemy, where Hindoo kings are believed to have reigned 2,000 years ago, where semi-dependent Mussulman rulers undoubtedly governed Bengal before Richard Cœur de Lion died, and where Kai Kaus Shah, 1291, founded a sovereignty, which, under the different dynasties, one of them Abyssian, endured to 1537. These kings made Gour, by degrees, one of the greatest cities in the world—greater, as far as mere size is concerned, than Babylon or London. Mr. Ravenshaw, a civilian, who took photographs of every building he could reach, photographs published since his death, believes the ruins to cover a space from fifteen to twenty miles along the old bed of the river, by three miles in depth, a space, which, after allowing for the rich native method of life, with its endless gardens and necessity for trees, must have sheltered a population of at least 2,000,000. These kings must have been among the richest monarchs of their time, for they ruled the rice garden of the world, Eastern Bengal, where rice yields to the cultivator 160 per cent; they controlled the navigation of the Ganges, and their dominion stretched down to the Orissa, where the native princes—how strange it sounds now, when Orissa is a province forgotten, except for an awful famine!—were always defeating their troops. They spent their wealth necessarily mainly on a mercenary army, often in revolt, for their Bengalees could not fight the stalwart peasants who entered the army of the Kings of Behar, and their fleet could not always protect the weak side of the capital; but they covered the city with great structures, opened "broad, straight streets, lined with trees," and built inner and outer embankments of this kind:

"The boundary embankments still exist; they were works of vast labor, and were, on the average, about 40 feet in height, being from 180 to 200 feet thick at the base. The facing throughout was of masonry, and numerous buildings and edifices appear to have crowned their summits; but the whole of the masonry has now disappeared, and the embankments are overgrown with a dense jungle, impenetrable to man, and affording a safe retreat for various beasts of prey. The eastern embankment was double, a deep moat, about 150 yards wide, separating the two lines. A main road ran north and south through the city, its course being still traceable by the remains of bridges and viaducts. The western face of the city is now open, and probably always was so, having been well protected by the Ganges, which, as has already been observed, ran under its walls. In the center of the north and south embankments are openings, showing that

these fortifications have been perforated to afford ingress to and egress from the city. At the northern entrance there are no remains, but at the southern still stands the Kutwali gate, a beautiful ruin, measuring fifty one feet in height, under the archway. Within the space inclosed by these embankments and the river stood the City of Gour, proper, and in the southern corner was situated the fort, containing the palace, of which it is deeply to be regretted that so little is left. Early in the present century there was much to be found here worthy of note, including many elegantly carved marbles; but these are said to have become the prey of the Calcutta undertakers and others for monumental purposes. On the roadside, between the palace and the Bhagirathi River, there now lies split in twain a vast block of hornblende, which, having been carried thus far, has been dropped and left as broken on the highway, to bear its testinony against the spoilers. Surrounding the palace is an inner embankment of similar construction to that which surrounds the city, and even more overgrown with jungle. A deep moat protects it on the outside. Radiating north, south, and east from the city, other embankments are to be traced, running through the suburbs, and extending in certain directions for thirty or forty miles. These include the great causeways or main roads leading to the city, which were constructed by Sultan Ghivasuddin. The greater part of them were metaled, and here and there they are still used as roads, but most of them are, like those within the city, overgrown with thick jungle."

Within the embankment, ten miles by three, the kings constructed splendid mosques by the dozens; palaces, public buildings, deep and huge reservoirs, and so many houses, that after three centuries of spoilation, "there is not a village, scarcely a house, in the district of Maldah (which is as big as an English county), or in the surrounding country, that does not bear evidence of having been partially constructed from its ruins. The cities of Murshidabad, Maldah, Rajamahal and Rangpur, have almost entirely been built with materials from Gour, and even its few remaining edifices are being daily despoiled." The kings built in brick and stone, and used for many mosques a material which Mr. Ravenshaw calls marble, but is more like what a hard freestone would be if it could be a deep coal-black. The quarries from which the material was obtained are still, as far as we know, uncertain; but it must have existed in enormous quantities; it took the chisel perfectly, and it appears inaccessible even in that destructive climate, to the effect of time. We have seen a mantelpiece of it, engraved with the Mohammedan profession of faith, known to be 800 years old, and the letters, cut to the depth of a line, are as clear as if the work had been done yesterday. The Gour architects built splendid Saracenic arches, gateways, and domes, and spared no expense or time on elaborate decoration, in a style which deserves separate study, for it marks the deep influence of Hindoo antiquities on men who were recently Mussulmans, and probably Moors from Spain. There is evidence that the grandeur and luxury of the city made a deep impression in Asia, for in one or two of the later Arabian stories it is treated as country-folk treat London;

while its civilization and polish so impressed the people, that to this hour a Bengalee Pundit, desirous of describing and honoring his native tongue, calls it not Bengalee, but *Goureye bhasha*, "The tongue of Gour," just as a Frenchman says, "That is Parisian."

And then, as it were in a day, the city died. The native tradition is that it was struck by the wrath of the gods, in the form of an epidemic, which slew the whole population; but it is more reasonable to believe, with Mr. Ravenshaw, that the epidemic, probably akin to cholera, finished a ruin partly accomplished by war and by the recession of the Ganges, which, after cutting its way into a channel four miles off, is now slowly cutting its way back again.—*London Spectator.*

A SHORT STORY OF THE OBELISK.

BY LIEUT.-COMMANDER GORRINGE.

Lieut.-Commander Gorringe, who has successfully brought the obelisk from its Alexandrian home to our Central Park, told the story of the Egyptian monument before the New York Association for the Advancement of Science and Art in the Brick church, at Fifth avenue and Thirty-seventh street, last evening. Thirty-five centuries have passed, he said, since the obelisk was severed from its natural surroundings by the hand of man and wrought into its present form. On the banks of the Nile, about six hundred miles from the sea, is an immense mass of granite, known as syenite, noted for its freedom from cracks, veins or foreign substances, and the beautiful polish of which it is susceptible. An obelisk now standing at Heliopolis, five miles from Cairo, taken from this quarry, was erected more than four thousand years ago; and four thousand years ago a priest quarried from this place, and transported six hundred miles, a shaft weighing one hundred and fifty tons, which was so highly polished that the polish still remains. With all the science of our own day, it would tax the most skillful workmen to reproduce the figures cut upon that shaft, and then give the surface such a lasting polish.

"On the base of the obelisk of Hatazon," continued the speaker, "it is recorded that only seven months elapsed from the time she gave the order to quarry the stone to the date of its final completion. To me this record means that the ancient Egyptians were possessed of mechanical appliances superior to those in use at the present day. By taking time enough, and employing men enough, there is hardly a limit to the weight that can be moved, but in the creation, transportation, and erection of an obelisk, the number of men is limited to comparatively a few, and I am quite sure that there is not a man living who would undertake in seven months, upon the penalty of his life, to quarry, transport six hundred miles, erect, carve and polish a granite shaft one hundred and twenty feet long, weighing three hundred and fifty tons, such as that of Queen Hatazon at Karnak. I dwell on this fact so that you may realize that in spite of the won-

derful progress made in the mechanical arts of this country, we are, perhaps, only on the threshold of the knowledge possessed by the ancient Egyptians thirty-five centuries ago. In my opinion an obelisk is simply the representation of the creative power; it was unquestionably designed to stand before a temple; the proportions between its heighth and that of the wall or pylon against which it was seen projected, were invariably such that from every point of view the pyramidion of the obelisk was seen above the top of the temple. Obelisks are always erected in pairs; unfortunately, we have but one, and it is not reasonable to expect that we can get another one from Egypt; in fact, I have good ground for assuring you that there is not the least hope of our getting another Egyptian obelisk, until we can buy one from the European residents of Egypt. But I can see no reason for not having another obelisk, cut out of the beautiful red granite of Connecticut, and erected on a neighboring knoll, on which there could be cut a brief historical record."

He then gave an extended account of the hieroglyphics, which have before been fully described, and gave some facts about Thothmes III., Rameses, Thebes, Memphis, and Lucius Verus. "Thothmes was enabled to conquer Asia and exact tribute from the most powerful Asiatic kingdoms. He built new temples and restored others that had been destroyed by the Asiatic conquerors. Among the latter was the Temple of On at Heliopolis. Before that temple he erected a pair of obelisks, of which ours is one.

"Cleopatra had nothing to do with our obelisk. She died eight years before it was removed by the Romans from Heliopolis to Alexandria, for, as you are doubtless aware, the Latin and Greek inscription on the claw of the copper crab, found between it and its pedestal, states that it was re-erected at Alexandria in the eighth year of Augustus, which correspond to the twenty-third before Christ."

—*New York Times.*

STEAM HEATING FOR CITIES.

To speak of a man's warming his hands in his own parlor by the heat of a fire a mile distant suggests an exploit of sorcery; yet for several years such a thing has been possible to the citizen of Lockport, N. Y. If he will, he may break up his stoves and sell them for old iron: one furnace is henceforth to do the work of a thousand, and distribute its heat to the houses of an entire city by the agency of the good servant, steam. The process was invented and put into practical operation by Mr. Birdsill Holly.

Near the center of the city stands a plain brick building, from whose one tall chimney clouds of black smoke are constantly ascending. This is the boiler-house, and here in a row are the four great boilers in which the steam is generated. Three are horizontal, fifteen feet in length by five in diameter. The fourth is of about the same capacity as its companions, but different in shape; it looks like a gigantic bell dropped down upon the furnace, and is familiarly known to

the workmen, not as "the upright," but as "the nigger." An iron pipe, eight inches in diameter, receives the steam from these boilers; yonder, back of the nigger, it passes into the ground. Outside the building, we might trace its course along the street by the black line of bare soil, from which it has melted away the snow.

This pipe is laid at a depth of three feet below the surface, sheathed in non-conducting materials, and inserted in logs of wood bored for the purpose. As the distance from the boiler-house increases, it diminishes in size from eight inches to one or one-half, to correspond with the amount of steam passed through it. At intervals of one or two hundred feet are placed wooden "service boxes," in which the expansion and contraction of the pipe under different temperatures is provided for by a nickel joint; from these boxes, also, the branches of the main diverge, and the service pipes are sent out to the buildings heated. The whole distributing system is divided into sections, from any one of which, in case of necessity, the steam can be excluded, without affecting the others.

As it is but a few years since this new method of heating had its origin in Lockport, we cannot expect to find it universally adopted. But here is a pleasant, home-like, private house warmed these two winters by the city furnace, from which it is distant perhaps half a mile. It is a cold, January day, but, as the outer door closes behind us, we find ourselves in a genial, summer-like atmosphere. No cheerfully glowing grate, no ugly, black register, is to be seen in the parlor; against the wall stands the radiator, with its polished marble cap and single row of delicately painted tubes. It is a hint of the housekeeper's millennium, when dust and coal-ashes, her omnipresent foes, shall be brought into subjection.

In the kitchen the family washing is in progress without any aid from the stove. Heat is conveyed to the boiler and tubs through rubber tubes attached to the service pipes. The water in the bath-room above is heated by a similar arrangement. There is no nerve-startling hiss as the steam escapes; that ingenious invention called the "anti-thunder box" reduces it to perfect quiet.

In the basement, also, we find the regulator. Perhaps at this moment the pressure in the boiler and mains may be forty or sixty pounds; in the house, as we ascertain by glancing at the gauge, it is only five. This reduction of pressure is due in part to the fact that, upon reaching the regulator valver, the water of condensation contained in the pipes is wire-drawn, and thus to a great extent reconverted into steam before being diffused through the building. Connected with the regulator is a steam-meter, which registers the number of pounds consumed daily, and also the hour at which each radiator in the house is opened or closed.

What becomes of the used steam? It is condensed upon leaving the radiator, and, in the form of hot water, returns to the basement. There, within a brick-walled inclosure, it circulates through several coils of pipe, exposed to a current of cold air. This air, warmed in its progress through the cooler, passes upward by a register into the apartment above, which it serves to ventilate. The water accumulates in a tank, the surplus being discharged into the sewer. Dip

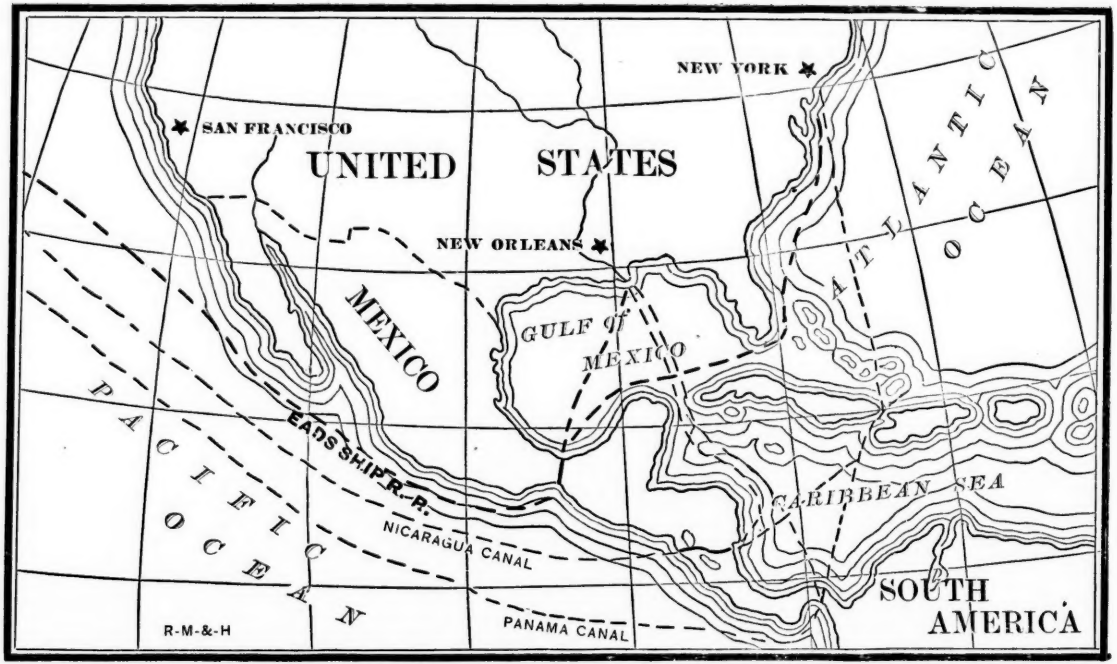
up a glassful from the tank. It is purer than a draught from any spring; it is the distilled water of chemistry. Should steam-heating ever become universal in our cities, there will be no danger of drawing up death from the well, no need of building expensive aqueducts and reservoirs; the same pipe that warm our houses will furnish us with water for every domestic purpose.

Steam has been made as subservient to the comfort of man as gas. What will science do for us next? Will the model city of the future be lighted by electricity, heated by one central furnace, and have its dinners sent in from the common kitchen through pneumatic tubes?—*Atlantic Monthly, March, 1881.*

PAPER CAR WHEELS.

How these are made are thus explained in the *Paper World:* "The paper is straw-board of rather fine texture. It is received in the ordinary broad sheets, differing in no particular from those used for straw-board boxes or other similar work. These sheets as they come from the paper mill are square, and are first cut to a circular pattern. This is done on a table with a knife guided by a radial arm. A small disc is also cut from the center of the sheet to admit the wheel center. The paper has now to be converted from loose sheets into a compact, dense body, capable of withstanding the tremendous crushing force to which it will be subjected in the wheels. This is accomplished as follows: Ten sheets are pasted together, one upon another, making a disc about ⅓ inch thick. Enough of these discs having been prepared to fill a powerful hydraulic press, they are subjected to a pressure of 1,800 pounds per square inch. When removed the discs are hung on poles in a steam-heated loft and left six days to dry. Thicker discs are then made, each formed by pasting together two or three of those already finished. These are pressed and dried as before, and the process is repeated until a block is built 4 inches thick and of about the specific gravity of lignum vitæ. After each pasting and pressing, six days are allowed for drying, and when the block is complete it is left in a drying room until thoroughly seasoned. The next operation is that of turning the paper blocks to fit the steel tires and iron centers. This is done in lathes in the same manner as if the material worked on was tough wood. A bed or recess is worked out for the web of the tire to rest in. The block is then painted, and is ready for its place in the wheel."

The Chicago, Burlington and Quincy Railroad Company are burning clay for ballasting their road. A small fire of bituminous Iowa coal is started on the surface of the ground, and, when burning freely, the fire is covered with a layer of lumpy clay, then alternately coal and clay, the coal decreasing in quantity until at the top it is as one to fifteen. The mass is formed like a cone. Three united cones, each 18 feet high and containing in all about 1,000 cubic yards of material, have been started near Red Oak. They will burn for months.



The above map shows in a practical form the advantages of the three Isthmian routes from the Atlantic to the Pacific, so far as distance and directness are concerned. Each of these routes has been fully described in the North American *Review* and other periodicals; but this illustration, adapted from Captain Eads' article, is the only one we have seen giving the three in one comparative view.—[EDITOR.

EDITORIAL NOTES.

AT the regular meeting of the Kansas City Academy of Science, in January, papers were read respectively by Mr. Coddington and Mr. David Eccles: the former upon the Cultivation of the Æsthetic in Industrial Pursuits, which was written in his usual elegant and attractive manner; the latter, a reply to Mr. Miller's criticisms of Herbert Spencer's philosophy, in which the author displayed his peculiar talent for metaphysical and philosophical discussion in a well and forcibly written defense of the Synthetic Philosophy.

At the meeting in February, Mr. Robert Gillham read the first of a series of papers on Sanitary Drainage of Cities, a subject to which he has given much attention, and one which is of vital importance to every citizen who expects to make this city his home. The second paper was read by Dr. R. Wood Brown, his subject being The Teeth in Relation to the Brain, illustrated by a large number of drawings prepared by himself, exhibiting the progressive development of the brain and teeth in the gradual ascent from the lowest to the highest grades of animal life. This lecture also was very instructive and was most attentively listened to by the audience.

At the March meeting papers will be read by Dr. Halley and Mr. Gillham.

MR. HOWARD W. MITCHELL, of Colorado Springs, Colorado, replies to an inquiry relative to the reported volcanic action on Pike's Peak, that "It is unnecessary to say that all such rumors are utterly without foundation in fact; no subterranean disturbance has, so far as known, taken place in Colorado during the past year, and the only remarkable atmospheric phenomenon was that which gave rise to the beautiful lunar rainbows a few nights since."

WE have received from the publishers a copy of Prof. T. Berry Smith's chart entitled "The Circle of Sciences," intended for the use of teachers in instructing their pupils in Physical Science. The circle is three feet in diameter, the center being Matter, Force, Change, with the various departments and subdivisions radiating out from it. It is a comprehensive and readily comprehensible chart, and will be found of great advantage to teachers and students.

AT the February meeting of the Kansas City Academy of Science, the Secretary called attention to the fact that the discovery of the *Icthyornis dispar*, the bird with teeth, ought, be credited to the late Prof. Mudge, instead of Prof. Marsh. The mistake is natural, as Prof Marsh figured and described this wonderful specimen, which was sent to him by Prof. Mudge.

A very partial friend at Plattsmouth, Nebraska, writes: "I receive most of the eastern and many foreign scientific periodicals, but not one which interests me as the REVIEW does."

BOSTON SOCIETY OF NATURAL HISTORY,
BOSTON, Mass., January 26, 1881.

* * * * *

We want several numbers of your magazine to complete our set. The society would be grateful to you if you could complete the set. Yours respectfully,

EDW. BURGESS, Sec'y.

COLUMBIAN COLLEGE, D. C.,
January 12, 1881.

DEAR SIR:—I do not know of anything during the past year that gave me more pleasure than your account of your trip to New Mexico.

* * * * *

Yours with respect,

OTIS T. MASON.

XUM

ITEMS FROM THE PERIODICALS.

THE *Rocky Mountain Medical Review*, edited by A. Wellington Adams, M. D., reaches Number seven of its first volume with the March issue. It is a handsome, ably conducted journal, published at Colorado Springs, Col. Among the original articles in the November number, besides that of Dr. Adams, on the Thermograph, copied in the REVIEW, this month, is a very excellent one upon "The Influence of Altitude upon Respiration," by S. E. Solly, M. R. C. S., which will be found of service to all who read it, whether medical men or invalids.

PRESLEY BLAKISTON, the well known publisher of medical works, in Philadelphia, has changed the title of his medical journal to *The American Specialist*, which is edited by Chas. W. Dulles, M. D., and published monthly at $1 50 per annum. It is attractive in appearance as well as valuable in substance.

THE *Humboldt Library*, Nos. 18 and 19, give respectively, "Lessons in Electricity," by Prof. John Tyndall, and "Familiar Essays on Scientific Subjects," by Prof. R. A. Proctor, at the usual low price of 15 cents each.

THE *Journal of the Anthropological Institute* (London) for November is just received. It presents a number of articles which cannot fail to interest its readers, among which are Notes on the Romano-British Cemetery at Seaford; Notes on Fijian Burial Customs; The Ethnology of Germany, etc., etc. This valuable periodical is published quarterly at $1 00 per number of 112 pages, and can be clubbed with the REVIEW at reduced rates.

HARPER'S MONTHLY for March offers the follows: Bedford Park, Moncure D. Conway; with eight illustrations. The University of Leiden, W. T. Hewitt; with ten illustrations. The Arran Islands, J. L. Cloud; with ten illustrations. Possibilities of Horticulture, S. B. Parsons; with nine illustrations. A Glimpse of an Old Dutch Town; with sixteen illustrations. Richard Henry Stoddard, a poem; Henry Ripley Dorr. The Grave-digger, Robert Herrick; with full page illustration by Abbey. A Nation in a Nutshell, Geo. P. Lathrop; with twelve illustrations. Anne; a novel, Constance Fenimore Woolson; with three illustrations by Reinhart. The French Republic, George Merrill. Hands Off; a story. A Talk on Dress, Maria R. Oakey. A Help-meet for Him; a story, W. M. Baker. The Family Life of the Turks, Henry O. Dwight. A Laodicean; a novel, Thomas Hardy; with an illustration by Du Maurier. Editor's Easy Chair; Editor's Literary Record; Editor's Historical Record; Editor's Drawer.

THE contents of *The Atlantic Monthly* for March, 1881, are as follows; Friends; a duet, VI—VIII; Elizabeth Stuart Phelps. Story of a great Monopoly; H. D. Lloyd. Arachne; Rose Terry Cooke. The Portrait of a Lady; XIX, XX; Henry James, Jr. The Seven Days; Francis L. Mace. New York Theaters. The Genesis of Genius; Grant Allen. Before Dawn; Maurice Thompson. The Wives of Poets, III; William M. Rosetti. The End of the War; Theodore Bacon. Random Recollections of England; Richard Grant White. Boston to Florence; Oliver Wendell Holmes. The Eleventh Hour; Katherine Carrington. Recent French and German Essays; War Ships and Navies; Tennyson's New Volume, and other Poetry; Challoner's History of Music; The Contributors' Club; Books of the Month.

THE *North American Review* has eight original articles by prominent writers, among which are Theology in the Public Schools, by Bishop A. C. Coxe; The Isthmian Ship Railway, by Captain James B. Eads, which is exhaustive in argument and fact, and which has one map that of itself is satisfactory evidence of the advantages of his route over all others; The Effects of Negro Suffrage, by Chief Justice H. H. Chalmers; The Success of the Free School System, by Prof. John D. Philbrick; Theological Charlatanism, by Prof. John Fiske, in which he handles Rev. Joseph Cook without gloves, etc., etc.

THE *Popular Science Monthly* is always welcome, but the February number is especially attractive, as will be seen from the following abstract of its contents: The Development of Political Institutions, by Herbert Spencer. IV. Political Differentiation.—Origin of the Plow and Wheel Carriage, by E. B. Tylor, F. R. S. (Illustrated.)—Physical Education, by Felix L. Oswald, M. D. II. Diet (continued.)—Horses and Their Feet, by Sir George W. Cox.—Domestic Motors, by Charles M. Lungren. III. Gas and Electric Engines. (Illustrated.)—The Value of Accomplishments, by William A. Eddy.—Darwin on the Movement of Plants, by Eliza A. Youmans. (Illustrated.) — Atmospheric Electricity, by Prof. H. S. Carhart.—Optical Illusions of Motion, by Silvanus P. Thompson, B. A., D. SC. (Illustrated.)—Evolution of the Chemical Elements, by Lester F. Ward.—Only a Vine Slip, by Thomas G. Appleton.—The November Meteors, by Prof. Daniel Kirkwood.—Prehistoric Science en Fete.—Sketch of Count Pourtales. (With Portrait.)—Editor's Table.—Literary Notices.—Popular Miscellany.—Notes.

THE *Saturday Herald*, recently enlarged and improved, is now the recognized society paper of the city, patronized by all and contributed to by many of our best and most elegant writers. Mrs. Hicks has displayed remarkable talent in working it up to the present standard and deserves a support ample to make it a profitable investment.

PREMIUMS.

We have determined to continue the plan which proved so appropriate and acceptable last year, for giving premiums to our subscribers, viz.:

To any person who sends us $3.50 we will send the REVIEW for one year, and any $1.50 book published by D. Appleton & Co., S. C. Griggs & Co., Robert Clark & Co., Houghton, Mifflin & Co., Harper Bros., Roberts Brothers, J. B. Lippincott & Co., John Wiley & Sons, Henry C. Lea, S. R. Wells & Co., Ivison, Blakenan, Taylor & Co., Orange Judd & Co., etc.

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To persons who wish to purchase law, medical, scientific or miscellaneous books, and at the same time subscribe for a periodical which includes within its scope popular articles upon all branches of science, mechanical arts and literature, we deem this a particularly favorable offer.

BACK NUMBERS.—To any subscriber for the fifth year we will furnish the back numbers of the first and second year for $2 25 each set, bound, or $1.25 each, unbound; and of the third and fourth years at $3.00 each, bound, or $2.00 unbound.

TESTIMONIALS.

As the fourth volume of the REVIEW will close soon, and we shall be asking our friends to renew their subscriptions, it may be well enough, by showing the estimation in which it is held by scientific men and periodicals in different parts of the country, to publish extracts from some of the encouraging letters and notices we have recently received. From them it will be observed that the REVIEW has met with favor not less in the East than in the West, and even in Europe it has found some readers of note who have been kind enough to express their appreciation of it and its management:

University of the State of Missouri,
Columbia, Mo., May 13, 1879.

THEO. S. CASE, Esq.:

MY DEAR SIR: I can but congratulate you on the excellence of your journal, and I will try and aid you with an occasional article,

Yours truly, G. C. SWALLOW.

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